Engineering Library

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The Engineer.

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VOL. CXLVIII.—No. 3853] LONDON: FRIDAY EVENING, NOVEMBER 15, 1929 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

Crown Agents for the COLONIES.

COLONIAL GOVERNMENT APPOINTMENTS.

APPLICATIONS from qualified candidates are INVITED for the following POSTS :—

M/1868.—ASSISTANT ENGINEER REQUIRED by the GOVERNMENT of TANGANYIKA TERRITORY for the PUBLIC WORKS DEPARTMENT for a tour of 20 to 30 months' service, with possible extension. Salary £480, rising to £600 a year by annual increments of £20, and thence rising to £720 a year by annual increments of £30. Free quarters and passages and outfit allowance of £30 on first appointment. Candidates, aged 25 to 30, unmarried, must have passed Sections "A" and "B" of the A.M.I.C.E. examination or hold professional qualifications recognised by the Institution of Civil Engineers as exempting from those examinations. Must be capable of levelling, surveying and measuring up work, and, in addition, to preparing neat drawings for the design of bridges, &c. Must have had at least three years' experience under a qualified civil engineer on the construction of railway works, drainage works, water supply or other public works.

M/1858.—ASSISTANT ENGINEER REQUIRED by the GOVERNMENT of BRITISH GUIANA for the PUBLIC WORKS DEPARTMENT for two years' service in the first instance and subsequent possibility of permanency on the fixed establishment. Salary £400, rising to £500 a year by annual increments of £25. Free first-class passages provided. Candidates, 24 to 27 years of age, unmarried, must have passed Sections "A" and "B" of the examinations to qualify for the A.M.I.C.E. Diploma or hold professional qualifications recognised by the Institution of Civil Engineers as exempting from those examinations. Must be capable of supervising construction of buildings and engineering structures, including road and bridge maintenance, with a knowledge of reinforced concrete, levelling and surveying, and the preparation of estimates.

M/1827.—ASSISTANT ENGINEER REQUIRED for the PUBLIC WORKS DEPARTMENT of the STRAITS SETTLEMENTS for four years' service, after which, subject to satisfactory service, the officer appointed will be eligible for confirmation in the permanent and pensionable establishment. It is probable that the number of permanent appointments will be sufficient for those officers whose services have been entirely satisfactory, but no guarantee can be given. If at the end of four years' service an officer's services have been entirely satisfactory and he is not offered or declines further employment, he will be paid a bonus of 2850 dollars. Salary 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax at present imposed by the Straits Settlements Government. Free passages provided. Candidates, age 22 to 26, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers, and possess a Civil Engineering Degree or obtain such other Diploma or Distinction in Engineering as the Secretary of State may decide in any particular case, or have completed articles with a civil engineer of good standing, and have passed the examinations for Associate Membership of the Institution of Civil Engineers. In addition, candidates must have had at least one year's practical experience of civil engineering under a qualified civil engineer.

Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting the reference number against the appointment for which application is made. 3746

The Government of BOMBAY INVITE APPLICATIONS FOR AN APPOINTMENT OF ASSISTANT MECHANICAL ENGINEER IN THE PUBLIC HEALTH BRANCH OF THE BOMBAY PUBLIC WORKS DEPARTMENT.

Candidates, who should preferably hold an Engineering Degree, must have had at least three years' training in the workshops of a first-class firm of pumping machinery engineers and have specialised for not less than five years in the design, erection and maintenance of waterworks pumping machinery. Age should be between 27 and 37 years. Pay in accordance with an age scale, e.g., age 27 years, Rs. 440 a month plus overseas pay of £15 a month; age 30, Rs. 520 a month plus overseas pay of £25; age 37, Rs. 800 plus overseas pay £30 a month. (Approximate sterling equivalents at present rate of exchange £576, £768, £1080 per annum.) Agreement for three years in first instance. First-class passage out and home. Provident Fund, travelling and other allowances under the usual rules. Strict medical examination. (Overseas pay and return passage admissible only to an officer of non-Asiatic domicile.)

Forms of application and further particulars may be obtained, upon request by postcard, from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor-gardens, London, S.W. 1. Last date for the receipt of applications 2nd December, 1929. 3711

The Government of BURMA invite APPLICATIONS for an APPOINTMENT as LECTURER in ELECTRICAL ENGINEERING at the Government Technical Institute, Insein, Burma. Candidates, whose age should preferably be between 25 and 35 years, should have taken a course in electro-technics at a recognised Technical College and should have had experience both in teaching and in engineering works. The officer will be required to give lectures in electrical engineering and to assist in carrying on the Electrical Department of the Institute. Agreement for five years in first instance. Free first-class passage out and home. In the event of renewal of agreement one free return passage home will be granted. Pay in accordance with an age scale, e.g., age 25 years, Rs. 350 a month plus overseas pay £20 a month; age 30, Rs. 475 a month plus overseas pay £20; age 35, Rs. 600 plus overseas pay £20. (Approximate sterling equivalents at current rate of exchange £555, £667, £780. Scale rises to Rs. 900 plus overseas pay £30. Provident Fund. (Overseas pay and return and leave passages admissible only to an officer of non-Asiatic domicile.) Strict medical examination.

Full particulars and forms of application may be obtained upon request by postcard to the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 6th December, 1929. 3702

The Engineer

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PUBLIC NOTICES

HEATING, &c.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Wednesday, 4th December, 1929, for ACCELERATED LOW-PRESSURE HOT WATER HEATING and FIRE SERVICES at the Sorting Office, Oxford.

Drawings, specification, a copy of the conditions and form of contract, bills of quantities, and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 3727

Wanted for the Metal and STEEL FACTORY, ISHAPORE (near Calcutta), one of the Indian Ordnance Factories,

An ASSISTANT WORKS MANAGER.

Applicants should be not less than 24 and preferably not more than 35 years of age. They should possess a University Degree of Non-ferrous Metallurgist or an equivalent Diploma. It is desirable that they should also have had five years' workshop experience in brass casting and rolling and/or rod and tube drawing shops, including experience in the handling of labour in some post of authority. Their knowledge and experience should embrace as many as possible of the following operations :—Melting, casting, rolling, extrusion, stamping and drawing of non-ferrous metals, and the production of small metal components.

The selected officer will be engaged for a period of five years, with the prospect of permanent retention thereafter. Pay will be at the rate of Rs. 600 basic plus £25 sterling overseas pay (in all about £70) per mensem, rising by increments of Rs. 50 per annum to Rs. 800 basic plus £25 sterling overseas pay (in all about £85) per mensem. (These rates apply only to an officer of non-Asiatic domicile.) The post is non-pensionable, but subscription to a Provident Fund, to which Government also contributes, will be compulsory. Free passage to and from India will be given on appointment and on termination of appointment, and if the officer remains in the service after the first five years leave passages to the United Kingdom will be granted.

The officer will be required to proceed to India early in the New Year.

Intending applicants should write to the SECRETARY, Military Department, India Office, London, S.W. 1, for further details of the appointment and for a form of application, marking their communications "Ordnance Recruitment." The latest date for returning the form will be the 23rd November, 1929. 3697

PUBLIC NOTICES

Armstrong College, NEWCASTLE-UPON-TYNE.

(IN THE UNIVERSITY OF DURHAM.)

COURSES for the PASS DEGREE of B.Sc. and the HONOURS DEGREE of B.Sc. in MECHANICAL, MARINE, CIVIL or ELECTRICAL ENGINEERING, MINING, METALLURGY, or NAVAL ARCHITECTURE. The curricula of the Pass Degree and the Honours Degree normally occupy periods of three and four years respectively, but candidates presenting evidence of sufficient previous training may be allowed to proceed to either Degree after two years' residence.

The engineering laboratories have recently been extended, and all Departments are equipped for advanced tutorial and research work.

Full particulars of the Courses may be had on application to

THE REGISTRAR,
Armstrong College,
3708 Newcastle-upon-Tyne.

Armourers' and Brasiers' COMPANY.

LECTURES IN METALLURGY.

The Company have arranged for the following LECTURES to be delivered :—

At the Royal School of Mines, Prince Consort-road, South Kensington, S.W., at 6 p.m. on 20th and 27th November and 4th and 11th December, 1929, by Professor SIR HAROLD CARPENTER, F.R.S., M.A., on "SINGLE CRYSTALS OF METALS AND ALLOYS—THEIR PRODUCTION AND PROPERTIES."

At the Northampton Polytechnic Institute, St. John-street, Clerkenwell, E.C., at 7 p.m. on 27th November and 4th and 11th December, 1929, by Dr. E. J. GOUGH, M.B.E., D.Sc., Ph.D., on "THE STRENGTH OF METALS IN THE LIGHT OF MODERN RESEARCH."

Admission free, without ticket. 3742

PUBLIC NOTICES

The Institution of Chemical ENGINEERS.

EXAMINATION, 1930.

Application forms (returnable 23rd December, 1929) and particulars of the Associate Membership Examination for 1930, together with the Memorandum on "The Training of a Chemical Engineer," may be obtained from the HON. REGISTRAR, Institution of Chemical Engineers, Abbey House, Westminster, London, S.W. 1. 3715

Bombay, Baroda and Central INDIA RAILWAY COMPANY.

The Directors are prepared to receive up to Noon on Wednesday, 4th December, TENDERS for the SUPPLY of :—

1. MATERIAL FOR BUILDING 15 YD CLASS LOCOMOTIVES.
2. STEEL PIPES, BOILER AND FLUE TUBES.
3. COPPER FIRE-BOX PLATES.
4. TYRES FOR LOCOMOTIVES.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.

Offices : The White Mansion,
91, Petty France, Westminster, S.W. 1.
12th November, 1929. 3739

PUBLIC HEALTH ACT, 1875.

Corporation of Newbury, BERKSHIRE.

CONTRACT NO. 2.
TO MACHINERY CONTRACTORS.

The Corporation of Newbury, acting as the Sanitary Authority for the said district, are prepared to receive TENDERS for PUMPING MACHINERY, &c. The works will comprise Electric Motors, Starting Gear and Centrifugal Pumps, together with ancillary Works, to be installed in or near the Engine-house at the Newbury Pumping Station.

Particulars and specification may be obtained at the offices of the Consulting Engineers, Messrs. Howard Humphreys and Sons, 28, Victoria-street, Westminster, on and from Monday, the 18th of November, until Monday, the 25th of November, between the hours of 10 a.m. and 4 p.m., upon payment of a deposit of Three Guineas, which deposit will be returned upon receipt of a bona fide Tender which is not subsequently withdrawn by the contractor.

The successful tenderer will be required to execute a contract and bond in a form to be prepared by the undersigned.

Tenders must be on the official form, each Tender in a sealed envelope, marked "Tender for Sewage Pumping Machinery." Tenders must be accompanied by the general conditions and specification as issued by the Consulting Engineers.

Each Tender must be signed in the handwriting of the tenderer or his authorised agent.

The Corporation does not bind itself to accept the lowest or any Tender.

Tenders must reach the undersigned by 9 a.m. on Thursday, the 5th of December, 1929.

Given under my hand the 9th day of November, 1929.

S. WIDDICOMBE,
Clerk to the Corporation of Newbury.
Municipal Buildings,
Newbury, Berkshire. 3719

South Indian Railway COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

MADRAS IMPROVEMENTS—
ELECTRIFICATION OF SUBURBAN AREA.
1. GALVANIZED STEEL LOUVRE BLADES, &c. (Car Shed); and
2. GLAZING (Car Shed).

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Galvanised Steel Louvre Blades, &c.," or &c. for each may be, with the name of the firm tendering, must be left with the undersigned not later than Twelve Noon on Friday, the 29th November, 1929.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 5s. for each copy of each specification.

Copies of drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.
91, Petty France, Westminster, S.W. 1,
13th November, 1929. 3740

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PUBLIC NOTICE

City of Leicester.

BELGRAVE SEWAGE PUMPING STATION. DISPOSAL OF PLANT.

The Sewage Works and Farms Committee invite TENDERS for the PURCHASE, &c., of various types of PUMPS, ENGINES, LANCASHIRE BOILERS, SUPERHEATERS, ECONOMISER, WATER SOFTENER, &c., PIPES, VALVES, &c.

Form of Tender, with conditions and full particulars of plant, can be obtained from the office of the undersigned, where permission to view may be obtained and drawings inspected.

Tenders, endorsed "Purchase of Plant, Belgrave Pumping Station," and addressed to the Chairman of the Sewage Works and Farms Committee, must be delivered to the City Engineer's office not later than Tuesday, December 10th, 1929.

The Committee do not bind themselves to accept the highest or any Tender.

A. T. GOOSEMAN, M. Inst. C.E., City Surveyor.

Town Hall, Leicester, November 7th, 1929. 3718

Royal Borough of Kingston-

UPON-THAMES.

SURPLUS ELECTRIC PLANT.

FOR SALE, the undermentioned PLANT, viz.:—

TWO MOTOR GENERATOR SETS, each comprising a Synchronous Motor, three-phase, 3300 volts, 50 cycles, 750 r.p.m., 1450 H.P., with Exciter, 60 volts, 200 amps., and Alternator, single-phase, 2100 volts, 75 cycles, 750 r.p.m., 1000 kW, with Exciter, 60 volts, 330 amps.

STARTING MOTOR, 3-phase, 3300 volts, 50 cycles, maximum speed 970 r.p.m., 340 B.H.P., with Liquid Starter.

ONE SWITCHBOARD, single-phase, 2200 volts, 77 cycles, with 27 panels, Tirrill Regulator, Synchroscopes, Voltmeters, &c., complete with Double Bus-bars and Mechanically Remote-controlled Switchgear, all manufactured in 1913 by Messrs. Switchgear and Cowans, Ltd.

Fuller details can be obtained on inspection at the Central Electricity Station, Down Hall-road, Kingston-upon-Thames, by appointment only.

Tenders to include dismantling and removing, but the Corporation will allow free use of crane at the risk of the purchaser.

Tenders to be received by the undersigned not later than the 25th November, 1929.

A. W. FORSDIKE, Town Clerk.

Municipal Offices, Kingston-upon-Thames. 3720

South Staffordshire Water-

WORKS COMPANY.

CIVIL ENGINEERING DEPARTMENT.

APPLICATIONS are INVITED for the APPOINTMENT of SECOND CIVIL ENGINEERING ASSISTANT.

Candidates must have had considerable experience in the design and maintenance of important waterworks, including impounding reservoirs, reinforced concrete service reservoirs, detection of waste, distribution and up-to-date administration of large waterworks undertakings.

Applicants must be corporate members of the Institution of Civil Engineers, having had responsible experience with a water company or Water Department of a Public Authority.

Commencing salary £500 per annum, which is subject to deductions under the Company's Superannuation Scheme.

Applications, stating age, details of education, training, qualifications and particulars of experience, accompanied by copies (only) of three recent testimonials, endorsed "Civil Engineering Assistant," must be addressed and delivered to the undersigned not later than the 27th November, 1929.

FRED. J. DIXON, M. Inst. C.E., Engineer-in-Chief.

14th November, 1929. Engineer's Office, 29A, Paradise-street, Birmingham. 3741

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, ASSISTANT SUPERINTENDENT for large works engaged on light mass production. Successful executive experience as well as good practical knowledge of tools and methods necessary.—Address reply, 3725, The Engineer Office. 3725 A

WANTED by Messrs. LEVER BROTHERS, Port Sunlight, an ASSISTANT to the MANAGER of the BUILDING and REPAIR DEPARTMENT. Applicant must have full experience of the building trades, both management of office and work on the site. Position requires full experience of factory maintenance, road construction and railway track, also the erection of reinforced concrete and steel-framed buildings. Applicant must have full experience of pricing and be able to prepare estimates, also be of good physique.

State age, whether married or single, and salary required. Only those with a character which will bear the strictest investigation should apply, with copies of testimonials, to be addressed "Private, Engineering Appointment," LEVER BROTHERS, Limited, Port Sunlight. 3722 A

WANTED, ENGINEER STOREKEEPER for Spain. Fluent Spanish essential.—Write, stating salary required, to Box N. 696, c/o Willing's, 133, Moorgate, E.C. 2. P6385 A

WANTED, Well-educated WORKS MANAGER for works of 400 hands. Up-to-date experience, control of men (indoor and outdoor) essential. A man of about 40 years of age with tact and initiative would find this an advancing position. Replies treated in strictest confidence.—Address, 3714, The Engineer Office. 3714 A

ASSISTANT ENGINEER WANTED for North Lincolnshire, with first-class experience in the erection and running of General Engineering Plant, including Steam Reciprocating Engines and Boilers. Salary approx. £350. Applicant to state age, experience, and technical training, and send copies only of references.—Address, 3724, The Engineer Office. 3724 A

ASSISTANT MANAGER WANTED by Importers of Machine Tools. Must have thorough knowledge of engineering practice and able to deal with daily correspondence on own initiative. State full particulars regarding previous experience, age, salary required.—Address, 3716, The Engineer Office. 3716 A

ENGINEER ASSISTANT for Waterworks near London. Good theoretical and practical knowledge of all classes of Waterworks Pumping Plant and Constructional Work essential. Must be used to designing and specifying.—Address, giving full details and salary required, 3712, The Engineer Office. 3712 A

ESTIMATOR WANTED for London Office of Conveyor and Structural Engineers. State experience and salary required.—Address, 3662, The Engineer Office. 3662 A

LOCOMOTIVE ENGINEER REQUIRED for appointment Service Engineer in Argentine. Must have running experience. Age not over 30.—Address, giving full particulars, experience, 3728, The Engineer Office. 3728 A

Gears
See large advertisement next week.
The Power Plant Co. Ltd.
WEST DRAYTON · MIDDLESEX

NEW AND REVISED EDITION.

ELECTRIC TRACTION.

By A. T. DOVER, M.I.E.E., A.Amer.I.E.E.,
Head of the Electrical Engineering Department at the Battersea Polytechnic, London.

A comprehensive treatise on the application of electric power to tramways and railways, written to meet the requirements of engineers and advanced engineering students. Owing to the considerable progress made in this direction since the first edition was prepared, the book has been thoroughly revised and largely re-written. Special attention is given to traction motors, systems of control, electric locomotives, motor coaches, computation of energy consumption, overhead construction, the trolley omnibus and its equipment, etc.

Medium 8vo, cloth, 734 pages, with 510 illustrations and 8 folding plates. Second Edition, 25s. net.

A detailed prospectus will be sent post free on application.

SIR ISAAC PITMAN & SONS, LTD.,
PARKER STREET, KINGSWAY, LONDON, W.C.2.

HILLIER, PARKER, MAY & ROWDEN.

By Order of the Receiver, Thomas J. Bond, Esq., F.C.A.

Messrs. HILLIER, PARKER, MAY & ROWDEN are instructed to offer for

SALE BY TENDER

UNLESS PREVIOUSLY SOLD BY PRIVATE TREATY

THE WESTERN VISCOSE SILK MILLS, BRISTOL,

and the PLANT, MACHINERY and GOODWILL.

The property is situate at Barton Hill, has extensive frontages to the G.W. Rly. and Canal, occupies a Ground Area of about TEN ACRES, on which are erected well-lighted substantial brick buildings, which for the most part are of modern construction, and together contain a total

FLOOR SPACE OF ABOUT 300,000 SQ. FT.

There is an ample water supply, excellent effluent disposal facilities, and the premises are equipped with the nearly NEW AND UP-TO-DATE COMPLETE

PLANT AND MACHINERY

FOR THE MANUFACTURE OF ARTIFICIAL SILK

including:

Viscose Spinning Machines, Horizontal Hydraulic Pulp Presses, Kneading Machines, Horizontal Churns, Mixers Spinning Containers, Ripening Containers, Filter Presses, Winding Machines, Reeling Machines, a Turbiex Patent Drying and Cooling Plant, Humidifying Plant, Ventilating and Heating Plants, Bundling Presses, Hydro Extractors, Seven 30ft. by 8ft. Lancashire Boilers up to 180 lbs., Permutit Water Softening Plant, Electrical Plant, including Sixty Electric Motors from 5 h.p. up to 80 h.p., Electric Pumps, Morris Electric Travelling Hoists, Vertical Air Compressors, Vertical Vacuum Pumps, Two Refrigerating Compressors, Avery Weighing Machines, up to 500 Kilos, Engineers' Tools, including Lathes, Drilling, shaping and screwing Machines, Office Furniture, loose plant, tools and utensils.

Tenders are invited for the purchase of the Property, Goodwill, and equipment of Plant and Machinery as a whole or alternatively, for the Property and Plant and Machinery as two separate lots, and should be delivered, marked "Tender for Western Viscose Silk Mills, Bristol," to the Receiver, Thomas J. Bond, Esq., F.C.A., 90, Cannon-street, London, E.C. 4, by 4 p.m. on FRIDAY, NOVEMBER 29th, 1929.

Forms of Tender, Orders to View the Works, and Particulars, Inventory, &c., may be had of THOMAS J. BOND, Esq., F.C.A., 90, Cannon-street, London, E.C. 4.
Messrs. VAUDREY, OSBORNE & MELLOR, Solicitors, 30, St. Ann-street, Manchester, or of Messrs. HILLIER, PARKER, MAY & ROWDEN, Auctioneers, Valuers, Surveyors, at their offices.

27, MADDOX STREET, LONDON, W. 1,

and 44, BRAZENNOSE STREET, MANCHESTER.

SITUATIONS OPEN (continued)

MANAGER REQUIRED for a Large Engineering, Shipbuilding and Docking Establishment in the Far East. Applications invited for this position. Replies will only be considered from men of ability with both technical and practical experience, having previously held a similar position, used to control and experienced in the highest class of marine engineering. Also some knowledge and experience in shipbuilding.—Applications, which will be treated in the strictest confidence, should give full details of past training and experience as well as age (40 to 45) and remuneration expected, and be addressed to 3750, The Engineer Office. 3750 A

MECHANICAL ENGINEER REQUIRED, with Locomotive and preferably Power-house experience for permanent appointment in Australia; age about 32.—Address, giving full particulars, experience, &c., 3729, The Engineer Office. 3729 A

MECHANICAL ENGINEERS REQUIRE TECHNICAL ENGINEERING CORRESPONDENT, with practical Shop Experience and ability to prepare Lay-outs.—Write, stating age, experience and salary required, 3596, The Engineer Office. 3596 A

MECHANICAL ENGINEER REQUIRED for North Borneo, to look after and effect running repairs to Light Locos., Winches, &c., used in connection with haulage of timber.

Plainly furnished bungalow in jungle provided. Salary about £450 per annum, rising £35 annually. Four years' agreement. Free medical attendance. Passages paid out and home.

Write, Box 655, Leathwait and Simmons, 34, Throgmorton-street, E.C. 2. P6390 A

NICE POSITION OPEN for ASSISTANT ENGINEER for Factory in France. Thorough knowledge of practical engineering, used to factory management, knowledge of French, first-class references.—Apply, Box 1205, L.P.E., 112, St. Martin's-lane, W.C. 2. 3738 A

REFRIGERATION AND COLD STORAGE.—Young MAN, with practical knowledge of above trades, good education and address, WANTED.—Address, P6384, The Engineer Office. P6384 A

SALESMEN WANTED.—Smart, Willing Men, of good appearance, who want to improve their position. Age not more than 35. Every opportunity given to learn a business that is progressive and permanent. This position will offer a good opening for men who have indoor jobs and who want to get outside. Salary £3 per week and liberal commission. You can earn £4 to £8 per week. Must be able to cycle.

Apply, JOHN BLUNDELL, Ltd., 196, City-road, E.C., any morning before one o'clock. P6386 A

WORKS MANAGER, Thoroughly Practical, REQUIRED for Non-ferrous Foundry in Midlands. Capacity about twenty tons per week. Must have full knowledge of latest methods of production, mixing of metals and costing.

The position open has good prospects and only men with first-class ability and experience need apply by letter to NEWMAN BIGGS and CO., Chartered Accountants, 133, Edmund-street, Birmingham. 3730 A

SITUATIONS OPEN (continued)

WANTED IMMEDIATELY, TWO Capable DRAUGHTSMEN (over 25 years of age). Must have experience in detailing Steel Bridge and Roof Work.—Applications, stating age, experience, and salary required, to FRANCIS MORTON and CO., Ltd., Hamilton Ironworks, Garston, Liverpool. 3721 A

WANTED IMMEDIATELY by Well-known Engineering Firm in the East Midlands, LEADING DRAUGHTSMEN, experienced with latest practice in Oil Tractors for agricultural and industrial purposes, also in Oil-driven Road Rollers of various types. Preference given to men experienced in both tractors and rollers, but those experienced in one branch only may apply. State age, experience, salary required, when at liberty. All applications considered strictly confidential.—Address, 3743, The Engineer Office. 3743 A

WANTED, JUNIOR DETAILING DRAUGHTSMAN.
(1) Salary 55s. per week.
(2) Age about 19 or 20.
(3) To draw and trace simple pump parts.
(4) To work in Chiswick.

Applicants for the above position should apply by letter to K.L.P.R., Ltd., 506, Abbey House, Westminster, S.W. 1. 3731 A

WANTED, JUNIOR DRAUGHTSMAN, Accustomed to Hoist Work, Elevating and Conveying Machinery. Only first-class man need apply. State age, experience, &c.—Address, P6391, The Engineer Office. P6391 A

A VACANCY Occurs for a SURVEYOR and DRAUGHTSMAN in G.W.R. Divisional Engineer's Office, Shrewsbury.—Particulars on application to the DIVISIONAL ENGINEER. 3713 A

CIVIL ENGINEERING DRAUGHTSMAN WANTED in Manchester Civil Engineers' Office for Power Station Construction. Experience in Reinforced Concrete Design desirable.—Address, stating age, experience, salary required, 3734, The Engineer Office. 3734 A

DRAUGHTSMAN, Engineers', for Quarry and Contractors' Machinery. State age, wage, and experience.—Address, 3634, The Engineer Office. 3634 A

DRAUGHTSMEN, Mechanical, REQUIRED AT ONCE. Some electrical knowledge an advantage, but not essential.—Address, stating age, salary required, and details of previous experience, 3660, The Engineer Office. 3660 A

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For continuation of Small Advertisements see page 4

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A Seven-Day Journal

Redundant American Warships.

WELL over sixty units of the United States Navy have been condemned to be scrapped at an early date. A clean sweep is to be made of the armoured cruisers, ten in number, which, in spite of being totally obsolete, have been retained on the active list up to now. Built between 1902 and 1906, the majority of these vessels were antiquated even before completion, owing to the introduction of the battle-cruiser type. The three largest are "Charlotte," "Missoula," and "Seattle," of 14,500 tons, with a mixed armament of 10in. and 6in. guns. They were improved editions of the "Huntington" and her four sisters, of 13,680 tons, with a main armament of 8in. guns. With these ships go the "Charleston" and "St. Louis," of 9700 tons, mounting twelve 6in. guns, which in general design bore a close resemblance to our old "County" cruisers. More than fifty destroyers have been sentenced to the scrap heap. All belong to the well-known "flush-deck" class, developed just after the United States entered the war and built on the principles of mass production. Many of these boats suffered from hasty workmanship, but on the whole the design has proved very successful. The average displacement is 1215 tons, the designed speed is 35 knots, and the standard armament comprises four 4in. guns and twelve torpedo tubes. The fifty boats to be deleted will be replaced by others from the dockyards at Philadelphia and Mare Island, California, where a great many destroyers paid off after the reduction of the battle fleet in 1922 have been laid up in reserve. Even after the condemned vessels have been scrapped the American Navy will still possess about 250 destroyers, its strength in this class of tonnage far exceeding that of any other navy.

More Details of the Leipzig.

WE are now able to publish more complete data of the "Leipzig," the fifth and last cruiser of Germany's post-war programme, which was launched at Wilhelmshaven on October 18th. Although of the same general design, this vessel differs in many important respects from the preceding ships "Königsberg," "Karlsruhe," and "Köln." She has a length on the water line of 544½ft., a breadth of 53ft. 4in., and at normal displacement, *i.e.*, 6000 tons, draws 15½ft. She is therefore shorter and broader than the earlier cruisers, and has appreciably less draught. Photographs taken at the launch show her to have pronounced bulges, which, besides affording protection against under-water attack, are fitted up as reserve oil bunkers. There are three propeller shafts, the outer two being driven by steam turbines and the middle shaft by an internal combustion plant, which, although installed primarily for cruising purposes, will also be in operation when the ship is running under full power. This plant, built in the M.A.N. shops at Augsburg, is of exceptionally light construction, and is designed to produce 12,000 B.H.P. The turbine machinery, taking steam from six oil-burning water-tube boilers, develops 60,000 S.H.P. Consequently, the total output of the propelling machinery is 72,000 H.P., and a speed of 32 knots is expected. With the oil engine alone in action the ship will have a speed of 18 knots and a radius of 2500 miles. By reducing the speed to 14·5 knots the radius would be increased to 3800 miles. Using the turbine engines alone the ship could steam 3200 miles. The cruising endurance of the "Leipzig" is, therefore, 7000 miles. If, however, the emergency side bunkers were full, the ship could cover a considerably greater distance at economical speed. The main armament of nine 6in. guns is carried in triple turrets on the centre line, one forward and two aft. In the "Königsberg" and her two sisters, which have finer lines, the after turrets are *en echelon*, an arrangement necessitated by the limited space available for shell rooms and magazine; but the increase of breadth in the "Leipzig" has made it possible to revert to a centre-line disposition. In appearance she differs markedly from her predecessors. All the boiler uptakes are led into a single but very large funnel casing, which stands well abaft the bridge. The "Leipzig" is of special interest as representing the latest development in German cruiser construction within the displacement limit of 6000 tons specified by the Versailles Treaty.

American Telephone Experiments.

AT the Bell Telephone Laboratory in America the latest results of researches, including the use of talking films, to assist in the operation of automatic telephones were recently demonstrated to a group of telephone engineers. The general introduction of talking film apparatus for the purpose of increasing the speed of communication between subscribers who have automatic telephones and those who have not, and of long-distance calls sent from automatic telephones through rural exchanges is expected in about a month. There are ten films, one for each number from zero to nine, recorded by an operator selected for the perfection of her "telephone voice." The films are wound on drums in the exchange and the dialling of the number required by the subscriber automatically releases the films, which begin to revolve, so that the voice recorded calls out the number required to the exchange operator. An improved method of ensuring the secrecy of radio-telephonic conversations was also demonstrated. The method involves scrambling the words of the message—*i.e.*, changing high frequencies to low frequencies and *vice versâ*—so that the conversation is completely unintelligible until the inverted conversation has been re-translated.

The World Engineering Conference at Tokio.

THE World Engineering Conference at Tokio, which was brought to a close on Thursday of last week, November 7th, has, in the opinion of all the delegates, fully justified the initiative and courage which was shown by Japanese engineers in inviting to their country representatives from the engineering industries of the whole world. During the Conference over eight hundred papers were presented and the sectional discussions were of high value. From all accounts it would seem that the organisation of the Conference was well carried out, and that the proceedings went very smoothly throughout. The language difficulty also appears to have been ably handled. High tribute is paid to the self-effacing way in which the Japanese engineers looked after the guests and to their generous hospitality. At the same time as the World Engineering Conference was in session, a sectional meeting of the World Power Conference was also held. Although this Conference was smaller than some of its forerunners, the quality of the papers presented was uniformly high, and some valuable and thorough discussions took place. Apart from the more technical papers presented, which dealt with typical problems and new developments in civil, electrical, mechanical, and marine engineering, several discussions took place upon the economic aspects of the engineering industry. In dealing with rationalisation in industry, it was, perhaps, noteworthy that the Japanese and European members, representing countries in which there is superabundant labour, were more inclined to advocate caution in the application of schemes which would bring with them labour displacement than were their American colleagues. The delegates were impressed by the vigour, enterprise and success of the Japanese engineering works, some of which our special correspondent in Tokio is describing in these columns.

Proposed Anglo-Swedish Train Ferry.

DURING the past week a party of members of the Swedish Parliament visited England for the purpose of conferring with British business men and other authorities on the proposal for establishing a train ferry between Gothenburg and Immingham. This scheme was outlined in a report on "Sea Communications between Sweden and England," which was recently prepared by the Board of Administration of the Swedish State Railways. In that report it was pointed out that direct and fast sea communication between this country and Sweden was of great importance in developing our mutual trade interests, and a service of train ferries was put forward as being more economical than a fleet of steamships. This report suggested that two or three train ferries should be built at an estimated cost of £330,000 each to maintain a service between Gothenburg and Immingham. Three trips in either direction weekly were proposed, each occupying two nights and a day, or 30½ hours, at a speed of about 16½ knots for the total passage of 504 nautical miles. Much time, it was pointed out, would be saved by the absence of loading and unloading delays, as the goods and passengers would be able to proceed as soon as the ferries were connected to the land. The success of the Trälleborg–Sassnitz and the Harwich–Zeebrugge train ferry was cited as strong evidence of the ability of such services to promote a rapid exchange of goods and to develop trade. It was suggested that the ferry would be best operated by a joint service between the interested railway companies in the two countries, namely, the State Railways of Sweden and the London and North-Eastern Railway in this country.

The Port of Liverpool.

IN the review of the work of the port of Liverpool which was given by Mr. R. D. Holt, the Chairman of the Mersey Dock and Harbour Board, last week, it is pointed out that the year ended July 1st was a record one both with regard to trade and finance. The total tonnage of vessels upon which dock tonnage was paid was 15,553,104, which represents an increase of 306,983 tons, compared with the previous year's returns. An increase of 3 per cent. was shown in the estimated weight of goods upon which dues were paid, which was 14,422,000, as against 13,970,000 tons in 1928. There was a total increase in the revenue of the Board of £164,882. An interesting account of the engineering work carried out in the port during the period under review is contained in the report of Mr. T. L. Norfolk, the engineer-in-chief. The northern extension works connected with the new Gladstone Dock are described, as are also the extensive improvements which are being made to the Princes Dock in order to accommodate the larger steamers and motor vessels which are being employed in the Irish coastal traffic. At the northern entrance of the dock the width is being increased from 44ft. 3in. to 60ft., while the sill is being lowered from 4ft. 1in. to 2ft. above the Bay datum. The repairs and maintenance of the Liverpool and the Birkenhead Docks are dealt with, and an account of the progress made with the Mersey Tunnel is given. Reference is made to the sale of the Clarence Dock site to the Liverpool Corporation for the erection of a large power station, and of the work which is being carried out for that scheme. During the past year the dredgers belonging to the Board removed no less than 18½ million tons of sand from the Bar and from the Queen's and the Crosby channels.

The Bolckow Vaughan-Dorman Long Amalgamation.

ON Tuesday, at meetings of the preference and ordinary shareholders of Bolckow, Vaughan and Co., Ltd., held in Manchester, the scheme for the amalgamation of the firm with Dorman, Long and Co., Ltd., was approved by the necessary majorities. Addressing the ordinary shareholders, the chairman, the Hon. R. D. Kitson, reminded his hearers that both firms controlled the full range of the raw materials required for the production of steel and that both were engaged in the structural engineering business. When the amalgamation was completed the combined output of the united companies would be about 1½ million tons of steel a year, or about 20 per cent. of the total steel output of the country. Dealing with some of the economics that will accrue from the amalgamation, he referred to the expense involved in maintaining a reasonable commercial range of rolls for the production of steel sections in a variety of sizes. The permanent investment represented by these rolls at one mill amounted, he said, to between £50,000 and £60,000. Under the scheme of amalgamation certain sections would be rolled at one mill and certain sections at another. The variety of rolls required to be kept at each mill would thereby be reduced, and in addition economy would be promoted by the fact that the rolls would have to be changed less frequently. Again, instead of two ironstone mines being run at a production of 5000 tons each per week, it would be possible to run one at 10,000 tons a week and place the other in reserve. The saving effected would be of the order of 1s. per ton of stone or 3s. per ton of pig iron. Summing up the general advantages, he said that the benefits of amalgamation were most clearly seen in times of depression. The power of an amalgamation to face either an expanding or a contracting market was greater than the sum of the powers of its separate components. The name of the amalgamated firm is to be "Dorman, Long and Co., Ltd., incorporating Bolckow, Vaughan and Co., Ltd."

Subway Explosions and Fires.

AT Tuesday's meeting of the London County Council, reports were submitted by various committees of the Council on the findings and recommendations of the Government Commission appointed to inquire into the cause of the explosions which occurred in the Holborn district last December. The General Purposes, the Highways, the Main Drainage, the Buildings Act, and the Fire Brigade Committees all presented their views on the subject. The most important opinion expressed in the different reports was that of the General Purposes Committee, to the effect that opposition should be offered by the Council to the Commission's suggestion for the establishment of a new authority to co-ordinate the control of underground services in London. The Committee objected to this suggestion because the constitution of the proposed body would require further legislation which would deprive some of the authorities of certain powers which they now possessed and because the new body, in order to obtain the funds required for the discharge of its duties, would presumably have to be given powers to levy rates. While it was admitted that the collation of information concerning underground services would be of great assistance in enabling the best use to be made of the space available, it was suggested that as a means to that end an extension of the powers possessed by the Minister of Transport under the London Traffic Act of 1924 would be preferable to the setting up of an entirely new authority. The Highways Committee reported against the Commission's recommendation that all underground cavities of any considerable size should be continuously ventilated. It stated that on the 160 miles of L.C.C. tramway line there were more than 3000 manholes; that the majority of these manholes were not ventilated in accordance with the Commission's suggested standard; that during the past twenty-five years no difficulty or accident had arisen in dealing with the accumulation of gas in these manholes; and that their satisfactory continuous ventilation would in many cases be impracticable and in all cases difficult and expensive.

Main Line Electrification on the Great Indian Peninsula Railway.

As announced in our last issue, Sir Frederick Sykes, the Governor of the Bombay Presidency, officially opened the new electrified services of the Great Indian Peninsula Railway on November 5th. The present electrified zone extends from Bombay to Poona on the south-east line and from Bombay to Igatpuri on the north-east line, the distance from Bombay to Poona being 119 miles and that to Igatpuri 85 miles. From Bombay to the junction of these lines at Kalyan, a distance of 33 miles, the tracks are quadruple and beyond Kalyan double. The suburban section, which may be taken as the zone up to Kalyan, has been operating for some years, and includes a branch known as the Harbour Branch from Bombay to Kurla, which feeds the dockyard and the cotton "go-downs" at Sewri. A connection is also made to the B.B. and C.I.R. from the harbour branch at Raoli Junction, and on it electric trains operate from Victoria terminus to Bandra, *vid* the Mahim chord. The route between Kalyan and Poona rises gently to Karjat, and from that point to Lonavla very sharp gradients are encountered on what is known as the Bhore Ghat, the ruling gradient being 1 in 37. Similar features also are met with on the line to Igatpuri, where the line rises by easy gradients to Kasara, from which point to Igatpuri over the Thull Ghat there is a similar ruling gradient of 1 in 37.

Power for the electrified lines is generated at a steam power station situated near Kalyan, which has a total plant capacity of 40,000 kW, and supplies current to that section of the electrification beyond Kalyan, the railway having an agreement with Tatas to supply all power required for the suburban electrification purposes from Victoria Terminus to Kalyan. From the generating station power is transmitted at 100,000 volts by means of duplicate transmission lines, one on each side of the railway route to eleven rotary converter sub-stations. At the sub-station, each of which contains two or three 2500 kW rotary sets, the power is transformed down from 100,000 volts, and converted into 1500-volt direct current for supplying the track.

The overhead equipment covers all the running tracks, and the majority of the sidings at the important stations are equipped for the purpose of train shunting. In some instances, however, steam locomotives will still be required to do certain of the shunting work and the marshalling of trains. Newly equipped workshops at Kalyan serve for the maintenance of the passenger and goods locomotives. There are also running sheds at various points, *i.e.*, Victoria Terminus, Poona, and Igatpuri, &c. Locomotives requiring heavy overhaul after perhaps a year's running—about 75,000 miles—will be sent to the main workshops at Parel. At Kurla there are well-equipped car sheds for dealing with the suburban multiple-unit stock and facilities for locomotive maintenance.

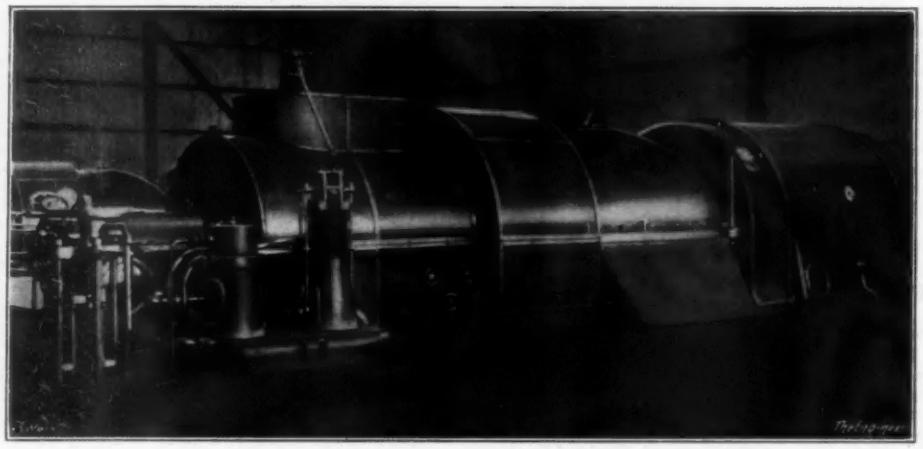


FIG. 1—10,000-KILOWATT PARSONS TURBO-GENERATOR

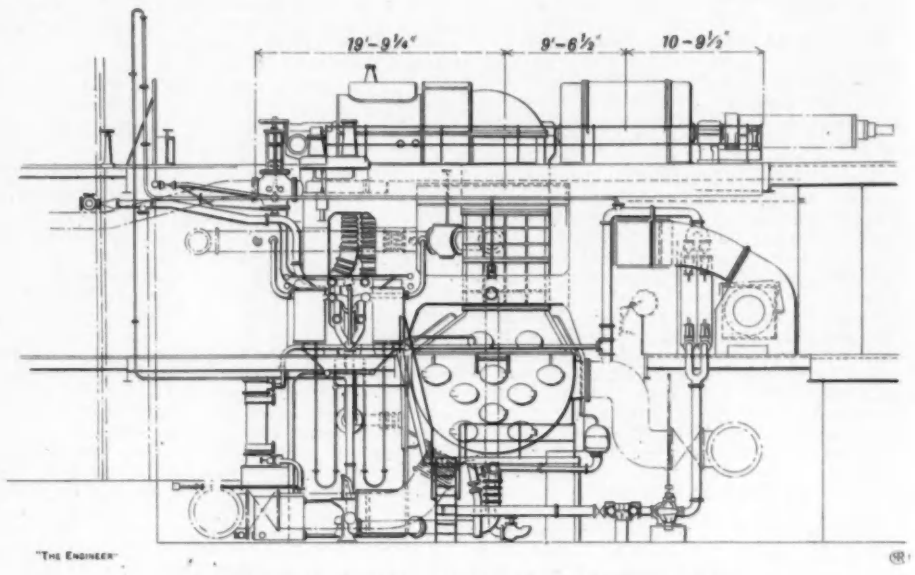


FIG. 3—GENERAL ARRANGEMENT OF TURBO-GENERATOR SET

The complete boiler-house equipment at the Kalyan power station was supplied by Babcock and Wilcox, Ltd., and is designed for a continuous maximum evaporation of 630,000 lb. of steam per hour, assuming all the boilers are working and are fired with both coal and oil fuel. There are six of these boilers, which are normally fired with coal. Each has an economical output of 60,000 lb. of steam per hour and a maximum output of 75,000 lb. of steam per hour at a pressure of 270 lb. per square inch. To meet the sudden fluctuations experienced on a traction system, however, each boiler is also fitted with oil fuel equipment, which is brought into action by a hand wheel at the front of the boiler, and when fired with coal and oil is capable of producing an additional 30,000 lb. of steam per hour. Each boiler is complete with its own superheater and Green's economiser. The turbine-room contains four 10,000-kilowatt, three-phase, 6600-volt, Parsons alternators—see Figs. 1 to 4—of the pure reaction type, designed for a normal speed of 3000 revolutions per minute, the steam conditions being 250 lb. per square inch at the stop valve, 700 deg. total stop valve temperature, and an exhaust vacuum of 28in. with the barometer at 30in. The expansion of the steam is effected in a series of forty-one stages, each of which comprises two rows of blading. The first thirty-five are end-tightened, while the remainder have ordinary radial clearance. The first blade height is $1\frac{5}{16}$in. on a diameter of 19in. The last blade height is $13\frac{3}{4}$in. on a diameter of 40in. Stainless iron blades are used throughout, and, as shown in Fig. 2, the rotor is of the conical type, so that there are no abrupt steps. While the most economical output of the turbines is 10,000 kilowatts, in order to cope with the severe load fluctuations and heavy overloads which are unavoidable on traction systems, each machine is designed to take a load of 16,500 kilowatts for two minutes. To secure this overload the first twenty pairs of blades are by-passed, and that allows for obtaining the maximum load when the steam pressure falls to 190 lb. gauge. The throttle valve which controls the supply of the main steam inlet is operated by an oil relay, supplied by a pump driven from the

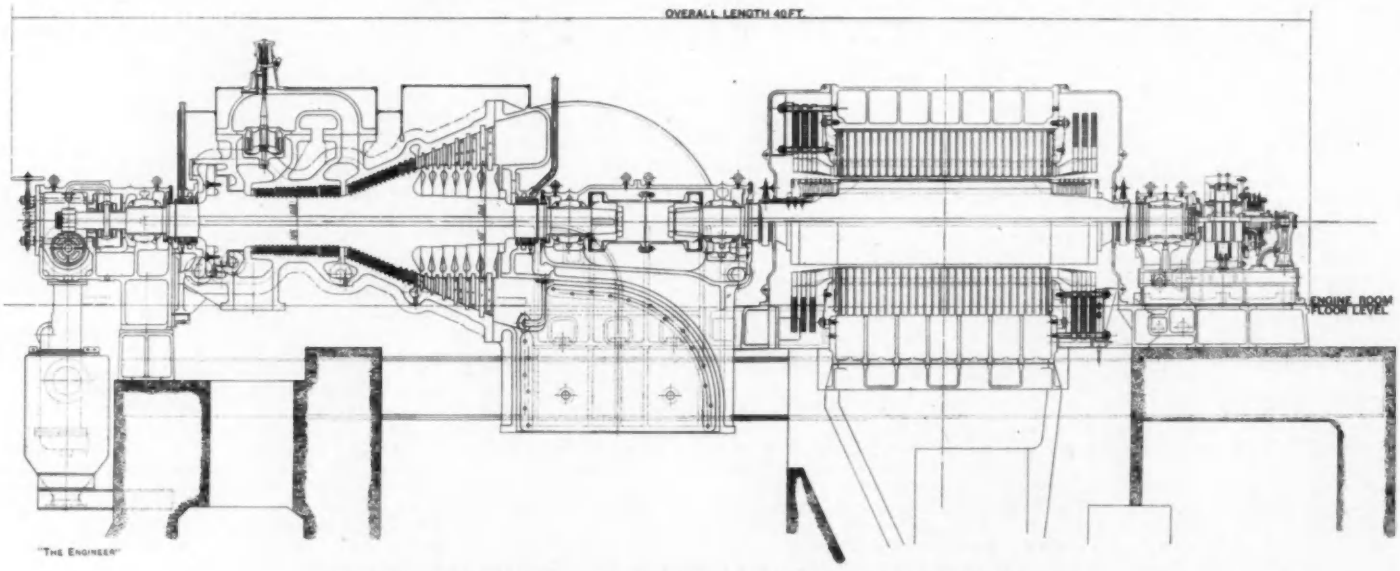


FIG. 2—LONGITUDINAL SECTION THROUGH 10,000-KILOWATT TURBO-GENERATOR

turbine shaft, and which is incorporated in the housing of the pump supplying lubricating oil to the bearings. Before passing to the turbine the steam passes through an emergency valve, which is operated by a runaway governor of the excentric bolt type mounted at the end of the turbine shaft, and when the speed exceeds

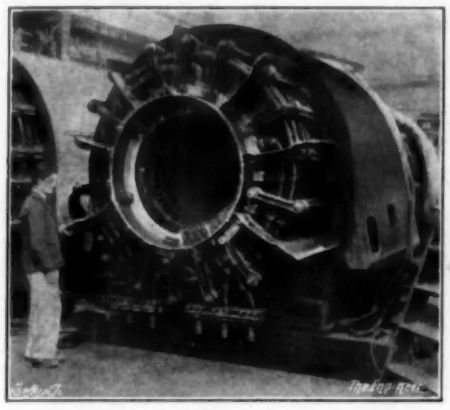


FIG. 4—ALTERNATOR STATOR

a predetermined value it operates the valve by means of a lever. Owing to the large diameter of the turbine rotors at the exhaust end and the consequent difficulty of forging the rotor in one piece, discs are used, and they are bolted together so that vibration is minimised. In accordance with the usual practice, an axial hole is trepanned through the centre of the

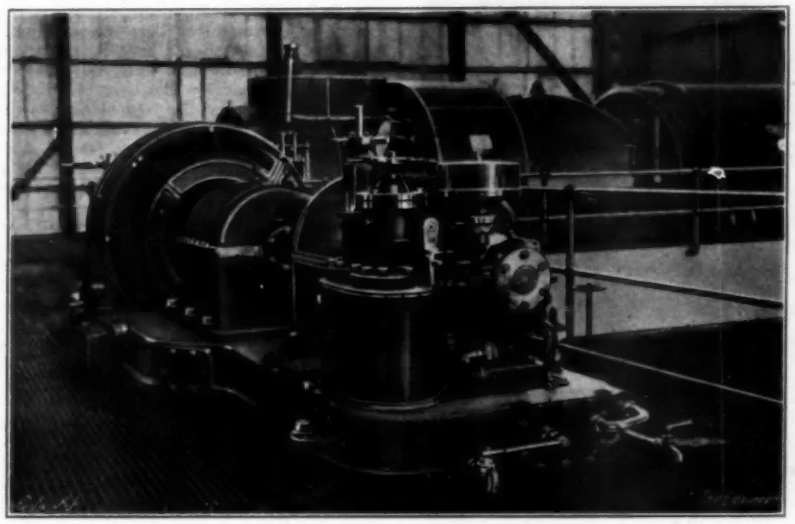


FIG. 5—350-kW HOUSE SERVICE SET

rotors, so that they can be examined internally.

Each turbine is complete with its own surface condensing plant, which is also of C. A. Parsons' manufacture. The condensers have an external cooling surface of 14,500 square feet, and they are arranged on the two-flow principle. In order to reduce the difference between the pressure at the exhaust inlet and the lowest pressure in the condenser to a minimum, the tubes are arranged so as to give the maximum inlet area and also to encourage the exhaust steam to flow to the lower tubes. The tubes are $\frac{7}{8}$in. external diameter. A steam jet-operated ejector air pump is coupled to each condenser. As is well known, this apparatus is the natural sequel to the vacuum augmentor which was first patented by Sir Charles A. Parsons in 1903. It consists of two stages, a primary and a secondary stage, and both steam jets exhaust into a feed-water heater and auxiliary condenser.

The heater and auxiliary condenser are in one casting, and form part of the ejector apparatus, the whole being one complete unit. The total cooling surface for both jets is 175 square feet.

C. A. Parsons and Co., Ltd., have also supplied two 415-volt, 350-kilowatt, non-condensing, house service sets, as shown in Figs. 5 and 6. The turbine speed is 9000 revolutions per minute, and the alternator speed 1500 revolutions per minute, the ratio of the gear thus being 6 to 1. The turbine speed is regulated by a Hartnell spring-loaded governor, driven through a worm and worm wheel from the turbine shaft, and the throttle valve is operated directly without the interposition of an oil relay. Stainless steel impulse blading is used throughout. The steam conditions of the set are 250 lb. per square inch, 700 deg. Fah. total temperature, and a back pressure of 5 lb. gauge. A feature of the open type alternators is that the insulation is so designed that, if the machines remain idle for a long time, they can be started up without having to be dried out. These sets serve for starting up the station after a shut-down, and may be idle for very long periods in a moist atmosphere. The circulating water pump-house contains three 350 H.P. vertical-spindle circulating water pumps, with a normal capacity of 16,000 gallons per minute and two of 175 horse-power with a normal capacity of 8000 gallons per minute. There are also three 6 H.P. motor-driven vertical-spindle bilge pumps for draining the sumps at the bottom of the circulating pump pits. The pumps and other pump-house equipment were supplied by the Mirrlees-Watson Company, Ltd., and the motors by the British Thomson-Houston Company, Ltd.

The 6600-volt switchgear controlling the generators is of the ironclad draw-out type, and each generator equipment is housed in a separate cubicle. The four main step-up outdoor transformers are situated in an outdoor sub-station adjacent to the power station, and are connected directly to the alternators without 6600-volt bus-bars. Each step-up transformer forms with its alternator a complete unit and consists of three single-phase transformers, which transform the pressure to 95,000 volts, each bank having a capacity of 11,000 kVA with an overload capacity of 18,000 kVA for two minutes. The E.H.T. outdoor type switchgear has been designed for a pressure of 110,000 volts. The auxiliary supply for the station is provided by 6600/415-volt, 1800-kVA transformers. One of these transformers is provided for each generating set, and each feeds a separate switchboard. The two house turbine sets are also connected to the 415-volt switchgear which controls the motor generator equipments and the various auxiliary motors. Four 415/110-volt, single-phase, 25-kVA lighting transformers are installed to supply the lighting circuits, and two 415/110-volt, 25-kW motor generators and a secondary battery for operating circuits, &c. The transformers were supplied by the Metropolitan-Vickers Electrical Company, Ltd., and the whole of the switchgear and the outdoor sub-station steel work by the English Electric Company, Ltd. Babcock and Wilcox, Ltd., supplied the coal and ash-handling plant. The power station has a well-equipped workshop in which it will be possible to carry out most of the repairs. The water supply for the boilers is obtained from the Bombay Development Department's reservoir at Budlapur, and the railway's reservior at Ambernath, but in order to guard against the failure of supply or the breakage of the pipes bringing the supply from these sources, evaporating plant can distil the water of the Ulhas River.

TRANSMISSION LINES.

Except over the Ghat section of the railway, where the physical features involve some deviation, the transmission lines which convey the current from the power station at Kalyan, run on both sides of the railway, and suitable precautions have been taken to avoid interference with telegraph and telephone circuits. The contract for this work, which was placed with Henleys, is now nearly completed, the work having been commenced in November, 1927. The working pressure is between 95,000 and 110,000 volts. The total length of the transmission lines is approximately 270 miles. There are about 2000 towers, each about 70ft. high, the usual span between them being 700ft. On the Bhore Ghat, it was decided that an additional line, which could be brought into operation in the event of trouble occurring on the other circuits, should be installed. In the construction of the line over the ghat there is a span between towers of 1750ft. The conductors consist of a stranded aluminium cable with a steel core, and altogether 840 miles of conductor wire was required.

SUB-STATIONS.

The supply of power to the overhead line is provided by eleven sub-stations situated at various points throughout the electrified section, the average distance between the sub-stations being about 12 miles. The sub-station buildings have a steel frame and the walls are composed of stonework. All the sub-stations, except Thakurvadi, receive their 110,000-volt supply from the power station by means of tee connections from the duplicate transmission lines, and these connections terminate on the structure of the outdoor sub-station, which contains the 110-kV oil switches and isolators and the step-down rotary converter transformers. Views of two sub-stations are given in Figs. 7 and 8.

Each rotary converter—Fig. 9—consists of two 750-volt machines connected in series. One of the special features of these rotary converters is a fan mounted on the armature which forces over 10,000 cubic feet of air per minute through the machine and over the commutator, and in order to ensure that this large volume of air does not fill the rotary with dirt or have an adverse effect on the machine, the air to it is drawn from outside the sub-station through an oil air filter. The outlet of this air is through louvres in the roof of the sub-station, and thus the sub-station building is ventilated. Each rotary converter set has a continuous capacity of 1666 ampères at 1500 volts and is able to give an output for one hour

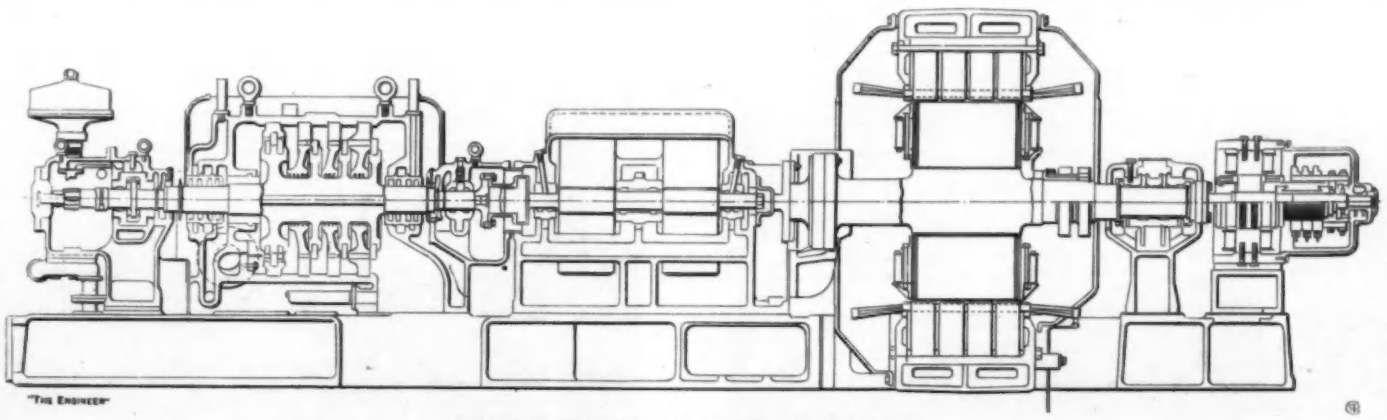


FIG. 6—SECTION THROUGH HOUSE SERVICE SET

of 2900 ampères; it is also capable of dealing with momentary peak currents of 6000 ampères. Of the eleven sub-stations, five are attended and six are operated from the attended sub-stations by means of a supervisory control system, the wires for carrying the current for operating the controlled sub-stations being carried on the structures supporting the track

equipment. At Thakurvadi, about midway up the Bhore Ghat, there is a sub-station which, owing to the physical features of the country, could not be fed from the 110,000-volt transmission line, and it was therefore arranged to supply this sub-station by means of a 22,000-volt transmission line from the Karjat sub-station, where two special transformers have been installed for this purpose. The complete equipment for the sub-stations and track sectioning cabins was supplied by the British Thomson-Houston Company, Ltd.

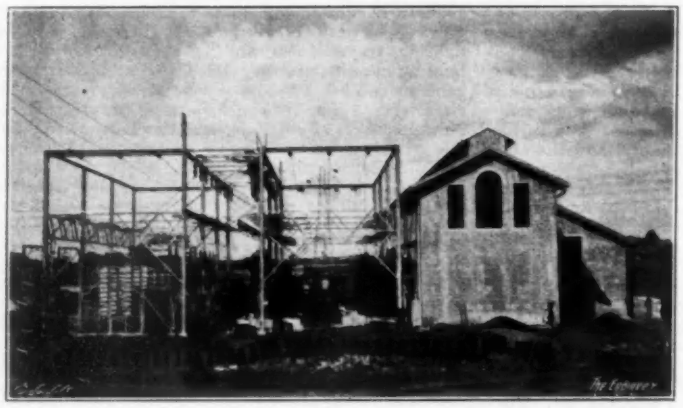


FIG. 7—OUTDOOR SUB-STATION AT VANGANI

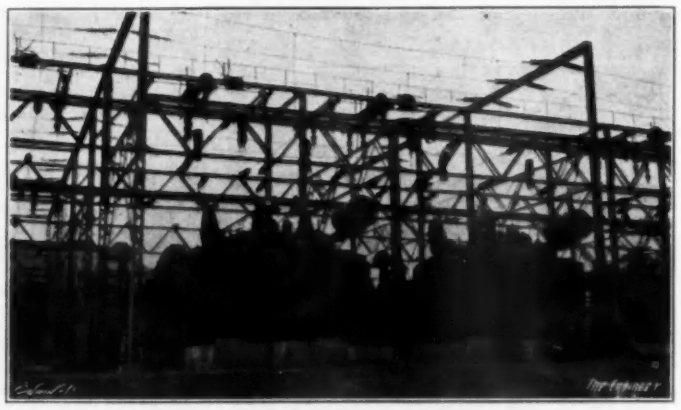


FIG. 8—STEP-DOWN OUTDOOR TRANSFORMING STATION

OVERHEAD EQUIPMENT AND PERMANENT WAY.

The lay-out of the system on the main line requires a larger section of copper than on the suburban system. On the suburban system 0·625 square inches of copper per track is employed on the running tracks, as against 1 square inch on the main line. The whole of the copper is incorporated in the catenary and contact wire system, and is utilised as follows:—0·5 square inch main catenary, 0·2 square inch auxiliary catenary, 0·3 square inch contact wire. All metal fittings used in the attachment and suspension of the conductor are of copper or other non-ferrous metal. On the open line the structures are built almost exclusively of broad flange beams, whilst in station areas structures fabricated of British standard sections are employed. The contract for the overhead equipment was placed with British Insulated Cables, Ltd., which also supplied the equipment for the suburban section from Bombay to Kalyan. The equipment is arranged for current collection up to 80 miles per hour, and an auxiliary catenary has been embodied in the design to ensure satisfactory collection. Another feature of the design of the equipment is the balanced overlap spans, which result in economy in steel work and copper. The electrified tracks pass over the Bhore Ghat on the south-east line and the Thull Ghat on the north-east line, the ruling gradient in the ghats being 1 in 37. In order to supply the Thakurvadi sub-station in the Bhore Ghat, a 22,000-volt, three-phase transmission line is carried on the track structures supported with pin insulators. The track structures carry the wires required for the remote operation of the sub-station. The return circuit of the current is by way of the running rails, which are bonded by two copper bonds under each pair of fish-plates. Routine tests are necessary to ensure that the bonds are maintaining the conductivity of the return circuit. Some examples of the overhead equipment is shown in Figs. 10, 11 and 12.

GOODS ENGINES.

With steam operation it was usual to haul the longest possible freight trains from Bombay to Karjat or Kasara, and to break them up at these points into smaller trains which could be conveniently worked over the Ghats. The reorganisation of this working a weight that they could be hauled over the complete journey without re-marshalling, the maximum loads being fixed at 1000 tons from Bombay and 1600 tons towards Bombay. It was decided that on the Ghats such trains should be handled by two electric goods engines, and that elsewhere one should be employed. This required an engine capable of exerting a tractive effort of 45,000 lb. to 50,000 lb. The design as ultimately decided upon consists of six driving axles, there being two trucks each with three coupled axles. The two trucks are pivoted and are also joined together by means of a flexible articulated coupling. The length over buffers is approximately 66ft., the rigid wheel base 15ft. 1in., and the wheel diameter 48in. There are no carrying axles, and the total weight, which is rather more than 120 tons, is all available for adhesion. Each truck contains a pair of motors which are geared together on to a single intermediate jackshaft. From the jackshaft the power is transmitted to the road wheels by means of connecting-rods. The total horse-power of the four motors in each locomotive is 2600. Powerful blowers are provided to blow air through the motors for cooling purposes.

FIG. 9—ROTARY CONVERTERS AT VANGANI SUB-STATION

At each end of the engine there is a driver's compartment, but apart from master controllers and a few small switches, the whole of the control equipment is housed in a high-tension compartment in the middle of the engine. This compartment is locked in such a manner that it cannot be opened until the pantographs are lowered and the whole engine has been made "dead." The control is of the electro-pneumatic type, and the four motors can be grouped in series, series-parallel, or parallel, thus giving speeds of quarter, half and full. Two stages of field control are also provided, so that there are in all nine economical running positions, in addition to starting notches. A special feature of these engines is that the control has been arranged for regenerative braking to assist in bringing trains down severe gradients. Each engine can exert a retarding effort up to 45,000 lb., and the engines have been tested for that regenerative effect by coupling two engines together and putting the controller of one into the motor position and of the other into the regenerative position. Both engines can thus be made to exert full load, one pulling forward and the other retarding, even if they are not coupled to a train. Tests have also been made with two "N" type steam engines hauling one electric engine regenerating.

Although the engines are specified to give a tractive effort on the one-hour rating of 50,000 lb., there have been occasions during testing when they have produced a tractive effort of 82,500 lb. (or nearly 37 tons).

The braking system adopted is a combination of the vacuum and compressed air system. Forty-one of these engines were ordered from the Metropolitan-Vickers Electrical Company, the mechanical parts of the first ten being built by the Swiss Locomotive Machine Works, and the remaining thirty-one by the Vulcan Foundry. The engines were dispatched in parts, and were erected at the railway workshops at Parel. More than half of the engines are now in use, a large number of them having been in service for more than a year. The operation has been satisfactory and has demonstrated that the type chosen is a suitable one.

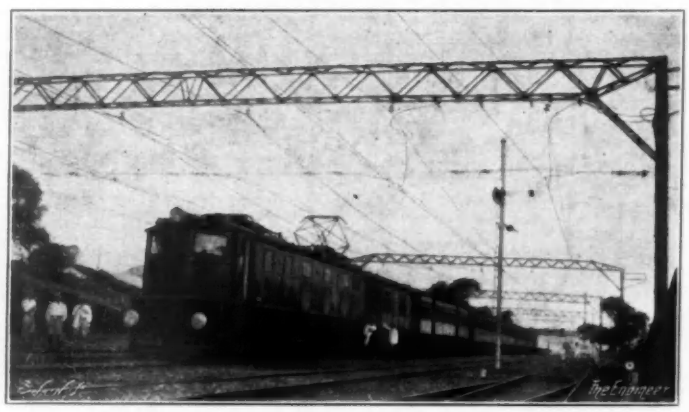


FIG. 10—PASSENGER TRAIN BETWEEN LONALVA AND POONA

FIG. 11—PASSENGER TRAIN AT KARJAT

PASSENGER ENGINES.

In order to ascertain the best type of passenger

ELECTRIFICATION ON THE G.I.P. RAILWAY

FIG. 12—CROSS SPAN EQUIPMENT AT VICTORIA TERMINUS, BOMBAY

engine for the conditions prevailing in India, three different types were ordered, one from the Metropolitan-Vickers Electrical Company Ltd., one from British Brown Boveri, Ltd., and the third from the General Electric Company Ltd. of England. Each of these engines had three driving axles, but the arrangement of the main drive, the carrying axles and the method of springing was different in each case. The mechanical portion of the Metropolitan-Vickers engine was built by the Swiss Locomotive Works, and that for the other two engines by Hawthorn, Leslie and Co.

After exhaustive tests in 1928 the order for the remaining twenty-one engines was placed with the Metropolitan-Vickers Electrical Company. All the engines were erected at the railway workshops at Parel, and are identical in almost every respect with the sample.

The engine is unsymmetrical, there being two carrying axles at one end and one at the other. The two carrying axles comprise a bogie of special design with spring control of the lateral and angular displacements. The weight of the superstructure is transferred to the bogie truck through a fore-and-aft equaliser with hemispherical pivots. The single carrying axle at the other end is combined as a truck with the adjacent driving axle, the arrangement being known as a "Java truck." The flexibility in the driving mechanism between the motors and the axles allows the driving axle to follow the movements of the truck, notwithstanding that the motors are mounted in the superstructure of the engine. The angular movements of this truck are also spring controlled.

The total weight is 102 tons, of which rather more than 60 tons is on the three driving axles. The weights on the axles are equalised into two groups, the two bogie axles constituting one group and the three driving axles and pony axle the second. The length over buffers is 53ft. 6in., and the rigid wheel base is 7ft. 6in., *i.e.*, the distance between two driving axles. The driving wheels are 63in. diameter and the carrying wheels 43in.

Each engine has six motors, giving a total horsepower of 2160. Each driving axle is driven by two motors mounted in line across the engine, with their pinions driving separate gears on a common intermediate shaft. On the centre of this intermediate shaft is a spur wheel which meshes with another spur wheel, which encircles the driving axle, but is carried in bearings which are part of the frame of the engine. Between this encircling spur wheel and the axle are links which give a flexible drive of uniform angular velocity, notwithstanding that the driving wheels may move relative to the engine, owing to inequalities of track, or, in the case of the Java truck, to cu vature of the track. This arrangement reduces the unsprung weight to a minimum, and allows the motors to be placed in a position where they are readily accessible, and raises the centre of gravity of the engine.

As in the case of the goods engines, the control is electro-pneumatic, but no regenerative braking is provided, as trains ascending and descending the Ghats will be assisted by goods engines. As there are six motors, the speed combinations are one-third, two-thirds, and full speed, but the use of the two field taps provided will permit variations on these, so that there are, in effect, nine economical running speeds, varying from approximately one-quarter to full speed. The characteristics of the motors have been so arranged that their speeds permit them to share the loads properly with the goods engines when hauling trains together over the Bhore Ghat. Passenger train engines will not be required to go over the Thull Ghat, all trains being dealt with on that Ghat by freight engines.

A driving cab is provided at each end with a central gangway down the middle of the engine. The high-tension apparatus and the resistances are housed in separate compartments on either side of the gangway, and access to them can only be obtained after the pantographs are lowered. The resistances are cooled by natural ventilation. Owing to the severe conditions under which both passenger and goods engines will work, a very large capacity of resistance is installed. Examples of two of the passenger engines and overhead equipment are shown in Figs. 10 and 11.

Exhaustive tests were made in 1928 by the chief mechanical engineer and the consulting engineers, Merz and Partners. The engine rode smoothly and without oscillation at speeds up to 80 miles an hour. As far as could be ascertained, the riding qualities of the engine were equally good in both directions. The motor equipment of the engine is such as to enable the engine to exert a pull corresponding to 1000 drawbar horse-power at 70 miles per hour.

World Power Conference, Tokio.

No. II.

GENERAL REPORT ON STEAM TURBINES (*continued*).

By Dr. MAKOTO SAITO.

HIGH PRESSURES AND TEMPERATURES.

In this paper Mr. G. A. Orrok, New York, states that although the pressure of 400 lb., with 700 deg. Fah. was tried in about 1915, it rose to 600 lb. in about 1921, and 1200 lb. in 1923, owing to perfection of materials, and that to-day there are a number of boilers operating at or around the critical point, 3200 lb. Langebrugge led in temperature rise in 1922 to 850 deg. Fah., and now Löffler has used 930 deg. Fah. for over a year.

Installation costs for high-pressure work have been shown to be only slightly in excess of standard construction costs, in general about 5 to 6 per cent. higher, although a number of authorities have found no excess cost. Practically every installation has reported commercial saving, but how much of these savings has been due to high pressures and temperatures, how much to the use of the regenerative cycle, and how much should be charged to improved operating methods is decidedly uncertain, but it is pointed out in all cases that the saving from the use of the regenerative cycle has been greater than from any of the other causes.

With rise in pressures and temperatures, the thermal economy of the plant has greatly increased. In 1922 the best stations delivered a kW-hour for a consumption of about 18,000 B.Th.U. in the fuel on a yearly average. That has been reduced in one station to 12,500 B.Th.U., while in at least six other stations yearly records of about 14,000 B.Th.U. have been obtained.

If we take the actual cycle on which any station operates and figure the theoretical heat efficiency in B.Th.U. per kW-hour in base load service, we can obtain a measure of economy of operation, if we know the actual B.Th.U. used by the station per kW-hour over a sufficiently long period, say, one year. The difference between these two figures in practice varies from over 6000 B.Th.U. to perhaps as low as 3500 B.Th.U., according to the operating condition. Well-operated stations show a difference of 4000 to 4500 B.Th.U., while the very best examples are usually a little below 4000 B.Th.U. Lastly, Mr. Orrok describes the improvement in system economics, through the tying-in of many communities in one system, as carried out to great length in the United States and also in other countries, including Belgium, where the possible benefits of a unified system of operation of all the power resources of the country have been studied in a comprehensive report, and the economics shown exceed by far the possibilities of improved thermal cycles.

He concludes, nevertheless, conservation of resources and the ultimate benefits coming from the use of power necessitate the prosecution of thermal improvement to the point where costs just balance the saving. That this point has not yet been reached is evident, and the future still holds promise for the engineer.

Under a similar title Mr. O. A. Wiberg, of Sweden, presented a paper describing the physical strength of metal at temperatures above 300 deg. Cent., in which he points out that, at such high temperatures, the material behaves in a manner resembling that of viscous fluids, *i.e.*, the deformation continues for long periods of time. For each material and temperature there is a certain stress at which this creepage will stop, after a certain time. The stress is defined as creep limit. In order to overcome this difficulty some power plants have been given a too high admission pressure in relation to a practically possible temperature, or have introduced re-superheating of steam, with resulting complication in layout and correspondingly high installation cost. To overcome these difficulties the study of the metal which will fulfil reasonable demands, not only with respect to yield point, ultimate strength and fatigue limit, but also with respect to creeping limit, is most important.

A series of tests under the author's supervision was carried out upon the following materials for comparative purposes :—

(1) Carbon steel with 0·15 per cent. C, normalised at 920 deg. Cent.

(2) Carbon steel with 0·50 per cent. C, normalised at 830 deg. Cent.

(3) Martensitic chromium steel (0·35 per cent. C, 13·5 per cent. Cr, hardened at 925 deg. Cent. in oil and tempered at 610 deg. Cent.).

(4) Austenitic chromium steel (Krupp V2A).

(5) Austenitic chromium steel (Firth Crown steel).

(6) Heat-resistive alloy (15 per cent. Cr, 61 per cent. Ni, 7 per cent. Mo, 15 per cent. Fe, 2 per cent. Mn, Heræus B7M).

(7) Heat-resistive alloy (15 per cent. Cr, 64 per cent. Ni, 20 per cent. Fe, 1 per cent. Mn, Heræus B).

These materials were subjected to the following tests at various temperatures up to 700 deg. Cent.:—

A. Short-time tensile strength tests. Continuously increasing from zero to the ultimate tensile strength in stages of 1 kilo. per square millimetre every two minutes.

B. Creep test at constant load and constant temperature.

C. Fatigue test with pulsating load (0 to +).

D. Fatigue test with alternating load (+ to −).

The results are shown in diagrammatic form, and it is of interest to note that for some of the materials —first two carbon steels—the alternating fatigue limit shows a marked increase in the region of 300 deg. to 400 deg. Cent., and, furthermore, for material of martensitic structure above a certain temperature —say, 300 deg. Cent.—the creep limit is lower than the alternating fatigue limit. The tests also show that for the two heat-resisting alloys the alternating fatigue limit at high temperature is higher than the pulsating fatigue limit. Then, explaining the utilisation of these materials with due consideration of their respective properties at various temperatures, the author has drawn two curves showing the thermal efficiency as a function of the admission pressure at various temperatures for a 50,000-kW turbine based on certain conditions.

It is worthy of note that the general shape of the carbon steel and chrome steel curves is fundamentally different from those of the other materials. The former give a fairly well-designed point of maximum thermal efficiency, whereas the latter give increasing thermal efficiency for decreasing admission pressures. This is due to the superior qualities of the latter material at high temperatures.

Although the carbon steel shows that scaling commences above 450 deg. Cent., the alloy steels 4 to 7 have very desirable qualities in resisting oxidation, so that it may be considered of the utmost importance to combine these qualities with more stable tensile

* No. I. appeared November 8th.

properties, and it is hoped that the metallurgist will solve this important question in the near future.

Axial-flow Turbines.

In this paper Messrs. Lindhagen and Lysholm, of Sweden, discuss the suitability of the radial-flow turbine combined with axial flow, for higher temperatures and pressures enumerating its many peculiarities. Comparing the said turbine with modern axial-flow high-efficiency turbines, the weight and cost of the former will be about 30 per cent. to 50 per cent. and 90 per cent. respectively of the latter, and the space of the complete installation of two 100,000-kW of the former type will be less than one 80,000-kW machine of the latter.

Radial-flow Turbines.

The author, Mr. O. A. Wiberg, of Sweden, states, first, that a discussion of large turbines is, primarily, a discussion of large exhaust area. To get ample area it is common nowadays to have two or more low-pressure parts in one casing or in independent casings, in order to reduce the centrifugal stress in the blades. The centrifugal stress on the blades is proportional to exhaust area at any given speed, independent of the relation of the blade length to the average diameter of the blade wheel, although it is not possible to increase the blade length only, as the efficiency of a steam turbine suffers from excessive blade lengths relative to wheel diameter.

Showing by numerous figures interesting examples of modern European and American tendencies to increase the operating economy by increasing the number of stages and the exhaust area of the turbine, the author points out that these turbines invariably have the complication of two exhaust branches to the condenser. By the latest design of Stal's radial-flow double-rotation type the steam exhausting from the radial-flow blading is led by two symmetrical passages directly to the guide vanes and to the corresponding rotating turbine wheels of an axial-flow section. Also, in order to facilitate the admission of the steam to the first-stage blade ring, the diameter of the ring has been made considerably larger than in the old design.

Capacity Limit of Steam Turbines.

Mr. B. Muto, Japan, says in this paper that the capacity limit of the direct-coupled turbo-generator has hitherto been considered as a problem associated with the generator side only, but lately the result of studies in connection with generator material and construction has tended to increase the capacity limit more and more. In fact, a 45,000-kVA machine with a speed of 3000 r.p.m. has already been constructed, and it is easy to imagine that a 50,000-kVA unit of the same revolutions will be developed in the near future. Then he proceeds to analyse and consider the limit of turbine capacity as follows. First, he takes the question of the maximum allowable centrifugal stress of the last row blade.

In the working stresses of a rotating turbine blade, it may be said that the centrifugal force is considered to be the limiting factor. After deducing numerous mathematical equations, he mentions an interesting example of 5 per cent. nickel steel blades, which had been in continuous operation for one year, during which time they had been subjected to a centrifugal stress of 1740 kilos. per square centimetre, and had shown no sign of trouble. The normal speed was 3600 r.p.m., and the mean peripheral speed 282·5 m. per second, the D/l being about 4.

Bearing many other points in mind, he suggests 1600 kilos. as the safe stress limit for the high efficiency turbine.

Secondly, regarding the exit angle of the last row of blades and the leaving velocity of the last stage, he says that if the leaving velocity is taken as 180 m. per second, the best exit angle to give the maximum capacity may be 30 deg. when $u \geq 280$ m. per second, while the angle of 35 deg., when $266 < u < 280$, would be a little more effective, but give less favourable influence on the turbine efficiency than the former. With these angles, though the peripheral speed increases above 266 m. per second, the turbine capacity is scarcely altered, and it seems clear that the peripheral speed of about 270 m. per second would not generally produce too severe stresses in the runner wheel so long as due consideration was paid to its construction. This is why the consideration of disc stress has been ignored in the paper. The author then turns to the effect of reheating and extraction feed heating, and says that it is likely that only along these lines will further advances in steam plant be seen in the future.

The author concludes that although the turbine capacity increases with the initial p essure and its probable limit cannot be found at least up to 160 atm. of pressure, there is too little prospective gain to justify an actual advance beyond 80 atm. as the plant efficiency attains its maximum between 80 atm. and 120 atm., either with reheating or without, and for a generator of 50,000 kVA running at 3000 r.p.m., a turbine with an initial pressure above 40 atm. would be satisfactory at this speed.

Conclusion.

The Reporter, having read with much appreciation the many valuable and interesting papers, wishes to draw attention to the following points :—

First, putting aside for the moment the cost of installation, the commercial efficiency of the whole installation is one of the most important factors for the plant owner, and not the thermal efficiency, because the turbine owner has no interest in academic ideas as to internal efficiency. Surely this commercial efficiency depends largely upon the various conditions prevailing at different stations, such as fuel price, heating value, &c. It is stated by one of the authors that about 14,000 B.Th.U. is the average consumption of fuel for sending out a kilowatt per hour, and, if that is so, let us make a comparison with the Diesel engine power plant which claims many superior points over the turbine installation, and is said to have a heat consumption of about 10,000 to 10,500 B.Th.U. (2500 to 2600 kilocalories) per kWh, with the cost of plant about the same in both cases. This consumption means that the thermal economy of the Diesel plant will be equal to that of the steam engine installation if the cost of oil is twice as much as the same weight of high-grade bituminous coal of 7200 kilocalories per kilogramme (13,000 B.Th.U. per lb.), or 6·41 times the cost of raw lignite of 2100 kilocalories per kilogramme (3800 B.Th.U. per lb.), assuming oil of 10,000 kilocalories per kilogramme (18,000 B.Th.U. per lb.) as fuel for the Diesel plant.

Secondly, the question of high steam temperatures, which is known to be a large factor in the improvement of thermal efficiency. The highest figures enumerated by the authors for those turbines actually in course of construction or its guaranteed figure at present, are something between 400 deg. and 450 deg. Cent. (750 deg. and 842 deg. Fah.), and it is added by practically every author that those limits are set by the durability of the constructional material available up to the present time. The last statement being one which we have heard for many years past let us see how far the limit has risen since the meeting of the Power Conference held in London in 1924. On that occasion Monroe gave something under 427 deg. Cent., Parsons 400 deg. Cent., Stork 400 deg. Cent., and Ferranti spoke of a turbine he had built in 1910 with a superheat of 400 deg. Cent. working without any undue difficulty. Comparing those figures of 1924 with those referred to in the papers of the present meeting, we may say that the rise in temperature is not as much as we would like to see. Can this be attributed solely to the slow progress of metallurgical researches ?

Consider the improvements which have been made upon some metal used in another kind of machinery. Take, for instance, the case of the aeroplane. On the occasion of the International Aeronautical Exhibition held at Olympia in 1920, only one all-metal aeroplane was exhibited, while in the Exhibition of this year, the exhibits included only one all-wood machine, which had been made merely for the purpose of experiment, all others being all-metal machines. Take the case of the Diesel engines. Progress has developed to such an extent that a unit was completed last year with an output of 15,000 H.P., although previously developments were considerably hampered by the difficulties of obtaining suitable heat-resisting materials.

While we must pay great respect and attention to the researches conducted by the turbine makers, such as the creep limit, to which reference has been made during the present meeting, however, more developments must be made by the metallurgists to obtain the requisite metal for the turbine, and it is only by the co-operation of turbine makers and metallurgists that early success may be obtained and the desired economical turbine made a sound commercial investment.

The New Italian National Experimental Tank in Rome.

On Sunday of last, week November 3rd, the official opening of the new Italian national experimental tank in Rome took place in the presence of Government officials. It is proposed, we are informed, to begin actual experimental tests in January next.

The new tank, which was visited by members of the Institution of Naval Architects on the occasion of the recent Summer Meeting in Rome, is noteworthy as being the best equipped and from the point of view of its harmonious dimensions, probably the finest tank of its type in the world. Since the year 1899–1900 the Royal Italian Navy has had at its service at the Royal Dockyard at Spezia an experimental tank which in its size and dimensions approximates closely to our own Admiralty Tank at Haslar. The dimensions of the Spezia tank are 150 m. in length, 6 m. in width, with a depth of 3 m., and a cross-sectional area of 17 square metres, the maximum speed of the carriage being from 4 m. to 5 m. per second. In view of the comparatively small dimensions of this tank and the fact that it is generally fully occupied with Italian naval work, the shipbuilders in Italy have often found it necessary to have their experimental work carried out either at the Hamburg or Vienna tanks.

In 1927 the Italian Government accepted a national proposal to build a large new tank for the special service of the shipbuilding industry and an appropriate Bill was drawn up and passed by the Government. Under it an independent body was entrusted with the building and equipping of the new tank, the funds for which were provided by the Bill. The Bill became law on June 23rd, 1927, and on April 21st of the following year active work was begun on the building of the tank and the administrative offices on a site near the Basilica of St. Paul, which was presented by his Excellency the Governor of Rome.

The new tank, four views of which are reproduced on page 524, has a length of 275 m., or about 902ft. 3in., with a breadth of 12·5 m., or just over 41ft., and a depth of 6·3 m., or close upon 20ft. 7½in. When completely filled, the tank contains about 18,000 metric tons of water.

The tank is of reinforced concrete, and the work was entrusted to the Ferro-Beton Company, of Rome, which adopted the Pali-Simplex system of piling for the foundations. About 1200 piles were driven, each with a length of 12 m., or about 39ft. 4½in. The mean thickness of the wall is 20 cm., or about 7⅞in. The two upper engravings on page 524 show a general view of the tank and the administrative buildings and an interior view. In the left-hand lower engraving we illustrate the model-preparing machinery and the tank laboratory and workshop.

All the apparatus needed for the casting and the machining of the models was ordered from three Austrian firms in Vienna, namely, the Ganser, Waggonbau, and Vulkan concerns, which carried out the work under the personal supervision of Dr. Gebers, the superintendent of the Vienna Tank.

The main carriage is designed for a maximum speed of 12 m. per second, and it is adapted for the testing of hydroplane models, as well as ships hulls and propellers. The electric motors on the wheels of the carriage each have an output of 36 B.H.P., and the current is supplied from a special 220-volt plant connected through transformers to the 27,000-volt high-tension transmission lines. A Ward-Leonard control system is utilised to produce an absolutely constant current and to regulate the speed of the carriage. The stationary electrical plant was supplied by the Electrical Society of Rome, the intermediate transformer plant by Marelli, of Milan, while the specialised carriage apparatus and controls were furnished by Siemens, of Vienna. A general view of the carriage is reproduced in the lower right-hand engraving. In the view of the workshop alongside there may be noted to the left the extra long casting troughs, and to the extreme right the model-shaping machine. This machine, which embodies Dr. Geber's latest patents, is designed to take a model up to 8 m., or 26ft. 3in., in length, and it will also operate on the vertical profile of the hull. An interesting piece of apparatus designed by Dr. Gebers is the measuring table shown to the left, which is furnished with micrometer gauges in three directions, enabling the hull appendages, bilge keels, hull axis, and the propellers to be set in position on the hull with absolute accuracy. The crane facilities for lifting the prepared models, and the arrangements for dry-docking the models and attaching them to the tank carriage, are such as to permit these operations to be carried out in a very short time.

The water for the new tank is obtained from an artesian well on the site, and it is raised to the surface by air, which is supplied by an electrically-operated compressor. An electrically-driven centrifugal pump serves to discharge the raised water into the tank.

The expense of the maintenance and operation of the new tank is provided for in a Government fund, and contributions are made to that fund by the principal Italian shipbuilding firms, and in a lesser degree by the Registro Italiano Navale ed Aeronautico classification society. We are indebted for the above particulars to General Giuseppe Rota, the President of the Tank, and to his assistant, Engineer Renato de Santis, who on the occasion of our recent visit kindly gave us every facility for inspecting both the tank and the well laid out administrative offices.

Developments of the Löffler System of Steam Raising.

The method of steam raising associated with the name of Professor Löffler, of the Charlottenburg University, consists in evaporating water by blowing highly superheated steam through it, the steam for this purpose being taken in a saturated condition from the boiler itself and forced through a superheater by means of a steam pump. Among the advantages claimed for the system is the fact that the boiler drum has not to be pierced for innumerable water tubes ; that it is not exposed to external heating, and that any deposits formed are entirely harmless, as the heat transmission is unaffected by them. On the other hand, a plant working on the principle indicated can only be started by means of some independent supply of steam ; the reliance on a steam pump may be regarded as a drawback and the transmission of the furnace heat to steam rather than to water also raises questions of a practical nature. Furthermore, the system is only applicable to the production of steam at very high pressures, for otherwise the density of the steam in the superheater is

insufficient to permit of a reasonable rate of heat transmission, without the pumping of enormous volumes. Indeed, in a recent article in *Le Génie Civil*, based on information supplied by Professor Löffler, it is stated that the whole of the power of the boiler would be necessary to drive the steam pump if the working pressure were as low as 285 lb. With a working pressure of 1400 lb., however, the power required for pumping is reduced to 2 per cent. of that produced by the plant, the volume of steam maintained in circulation being then 3·8 times the volume supplied for useful work.

In the article referred to, two commercial installations of the Löffler system are described, in addition to a short account of its application to a locomotive now in course of construction. The first plant supplies steam to the locomotive works at Vienna. It comprises two boilers, each 800 mm. diameter and 7 m. in length, producing together 17,460 lb. of steam per hour at a pressure of 1560 lb. per square inch and a temperature of 480 deg. Cent. (896 deg. Fah.). The steam circulation is effected by a two-cylinder vertical reciprocating pump fitted with piston valves. This pump is mounted on the same frame as the boiler feed pump. The latter is also of the two-cylinder reciprocating type, its pistons being driven from the crossheads of the steam pump by an adjustable linkage which provides means for regulating the rate of feed. The crank shaft driving the whole arrangement is driven in turn by a variable-speed electric motor. By means of an economiser, constructed in two stages for experimental purposes, the feed water is raised to a temperature of 280 deg. Cent. The plant is fired by chain-grate stokers. It furnishes steam to a vertical single-cylinder double-acting drop valve engine, capable of developing 600 H.P. at 300 revolutions per minute and exhausting against a back pressure of 170 lb.

The second installation is at the Witkowitz coal mines in Czechoslovakia. It produces 39,700 lb. of steam per hour at 1700 lb. per square inch and a temperature of 500 deg. Cent. (932 deg. Fah.), there being five boilers of the same size as those in the Vienna locomotive works. Firing is effected by means of pulverised fuel. The furnace walls are hollow and the secondary air circulation through them, combined with the effect of a superheater in the furnace itself, suffices to keep the walls cool enough to permit of the deposit of the ashes in the form of a powdery dust. The steam circuit comprises an auxiliary superheater in the form of a coil and the main superheater composed of hairpin tubes arranged vertically against the back wall of the furnace and thus exposed directly to the furnace heat. The gases on leaving the furnace pass first through the economiser and afterwards through an air heater, raising the temperature of the primary air to 300 deg. Cent. (572 deg. Fah.). The steam pump and the feed pump are combined, as in the previous case. At present they are motor driven, but later on it is intended to replace the motor by a low-pressure steam engine, of which the exhaust will be used for feed heating. The steam from the Löffler boilers, at 1700 lb. pressure, is employed to drive a turbo-generator of 18,000-kW capacity. This machine, however, cannot be fully loaded before another pair of boilers, now under construction, is ready for service. These boilers will produce an extra 88,180 lb. of steam per hour at normal load, or 110,200 lb. if forced. The steam pumps to be used in connection with them will be of the centrifugal type.

The results obtained with the Löffler boilers mentioned were considered sufficiently promising by the German State Railway Administration to warrant the placing of an order with the Schwartzkopf Company for a locomotive on the same principle. This machine, of 2500 H.P. and destined for express service, is at present under construction. It will use steam at 1700 lb. pressure and 500 deg. Cent. temperature. Its appearance will not be greatly different from that of an ordinary locomotive of the 2–C–1 type. It will have two outside high-pressure cylinders and one central inside low-pressure cylinder, with piston valves. The compounding, however, is to be indirect, there being two entirely distinct steam circuits connected by a heat interchanger, the latter acting simultaneously as a high-pressure condenser and a low-pressure boiler. The furnace, which is fitted with an ordinary grate, is surrounded by walls of steam tubes forming the main superheater. The gases then pass through an auxiliary superheater in series with the first, then through a low-pressure superheater which superheats the steam at 210 lb. generated in the heat exchanger for use in the low-pressure cylinder. An economiser and an air heater absorb further heat from the gases before they reach the chimney. The use of two separate steam circuits was adopted, apparently, mainly with the idea of keeping the deposits from the feed water in the heat exchanger, which is easily cleaned, rather than allowing a deposit to be formed in the high-pressure boiler drum. The arrangement involves the use of one main and one spare set of three pumps of three cylinders each; one pump to feed the high-pressure boiler with condensate from the heat exchanger, one pump to supply fresh feed to the low-pressure system, and one pump to circulate the high-pressure steam. To make up the losses in the high-pressure system another pump is provided, which takes low-pressure boiling water from the heat exchanger and delivers it to the high-pressure boiler. The exhaust steam from the low-pressure cylinder passes away to the chimney to form a blast. To start the process of steam raising, steam is supplied from an independent locomotive. It is hoped that the new Löffler locomotive will do its work with only about half the coal required by the best engines of the ordinary type, and that it will not exceed them in weight.

In some further notes on the Löffler system the security of operation is emphasised. The tubes exposed to the furnace heat are filled with dense steam, from which, of course, there is no possibility of deposits being formed in the tubes. The only place where any deposit can occur is in the boiler, where, instead of being a source of danger, the scale has a beneficial effect in minimising the escape of heat. Distilled make-up water is not necessary, ordinary chemical means of purification being sufficient. All danger of deposit in the economisers is said to be avoided by keeping the water velocity up to half a metre per second through the tubes. The steam at the very high pressures employed has properties comparable with water as far as the absorption of heat is concerned, so that the heating surface required is of the same order of size as that of ordinary boilers. The velocity of steam through the superheaters, usually fixed at 20 m. per second, is independent of the speed or even of the stoppage of the prime mover driven by it. The temperature of the superheated steam thus remains practically constant at all loads, and would only increase slowly with the temperature of the water in the boiler in case the fires were not regulated to the load. The sudden stoppage of the steam pump would expose the superheater tubes only to danger, and to protect them in such a case there is a tube fully exposed to the radiant heat of the furnace, the abnormal expansion of which is arranged to open a safety valve and short circuit the feed pump. There is, further, an automatic non-return valve at the superheater exit to prevent a back flow of steam and to limit the trouble if a superheater tube should burst.

The fact that the boiler drum is not pierced by tube holes in the usual way permits its thickness to be greatly reduced. Thus, a thickness of 65 mm. only is sufficient for a drum of 1100 mm. internal diameter under a pressure of 2000 lb. per square inch and a temperature of 500 deg. Cent. We may remark in parenthesis that the article from which these facts are taken does not indicate how such a temperature could exist in a drum containing any water at all, the temperature of saturated steam at this pressure being only 636·8 deg. Fah., or 336 deg. Cent. The boilers, the article continues, as well as the superheater tubes, ought to be constructed of hard Martin steel, with a breaking strength of 65 kilos. to 70 kilos. per square millimetre (41·3 to 44·4 tons per square inch) and an elastic limit of 11 kilos. per square millimetre (7·0 tons per square inch) at 500 deg. Cent. without deterioration with time. The piping ought not to be bolted, but carefully welded together, attachments being made by welded flanges with coned bearing faces ground together.

Experience has shown that at very high pressures an improvement in fuel economy of 30 per cent. can be obtained, in comparison with pressures of 200 lb. or so. As compared with pressures of 500 lb., the economy is 15 per cent. As regards capital costs, these increase by 30 per cent. for an increase of pressure from 200 lb. to 500 lb., and after that remain substantially constant. It would appear, then, that steam at a pressure of more than 1400 lb. per square inch and at a temperature of at least 500 deg. Cent. would provide the best working conditions for large central stations in the future.

The Law of Noise.

(*From a Legal Contributor.*)

At a time when the voice of him who complains that he is being disturbed by noise is heard in the land, it may be of interest to consider the answer to the question, To what redress, if any, is the sufferer entitled?

It were in vain to search the statute book, for, apart from one Act of Parliament which imposes penalties on the owner of a motor car who fails to use a silencer, there is no statutory enactment which deals with mere noise. Nor is there any Act of Parliament which confers upon any citizen the right to bring suit against any person or persons because his comfort is disturbed by this form of annoyance.

He who would seek redress must search the annals of the common law. He must invoke the aid of an ancient maxim familiar to lawyers in the Latin words, "*Sic utere tuo ut alienum non lædas.*" Freely rendered into the vulgar tongue, it means that no man must use his own property or conduct his own business in a manner which is calculated to cause damage or annoyance to his neighbour. That is the foundation of the English law of nuisance, which has been administered for generations by the Court of Chancery.

Consideration of various cases decided within the last half-century reveals the fact that our judges, when called upon to restrain the creation of noise by injunction, have not been able to lay down any general rule. In the well-known case of Soltau *v.* de Held (2 Sim N.S., 133), where an action was brought for an injunction to restrain the ringing of church bells, which was complained of as a public nuisance, Vice-Chancellor Kindersley said: "I conceive that, to constitute a public nuisance, the thing must be such as, in its nature or its consequences, is a nuisance—an injury or a damage, to all persons who come within the sphere of its operation, though it may be so in a greater degree to some than it is to others. . . . If, however, the thing complained of is such that it is a great nuisance to those who are more immediately within the sphere of its operations, but is no nuisance whatever, or is even advantageous or pleasurable to those who are more removed from it, there, I conceive it does not come within the meaning of the term public nuisance. . . . A peal of bells may be, and no doubt is, an extreme nuisance to a person who lives within a very few feet or yards of them; but to a person who lives at a distance from them, although he is within the reach of their sound, so far from its being a pleasure or an inconvenience, it may be a positive pleasure."

Thus was the law stated in 1851, and the principle enunciated by the Vice-Chancellor still holds good. He made it plain that it is impossible to enunciate any general definition of "nuisance by noise" which will be restrained by the Courts. As Chief Baron Pollock said in 1862 (Bamford *v.* Turnley, 3 B. & S., 66): "The question so entirely depends on the surrounding circumstances, the place where, the time when, the alleged nuisance, what the mode of committing it, how, and the duration of it, whether temporary or permanent, occasional or continual, as to make it impossible to lay down any rule of law applicable to every case and which will be useful in assisting a jury to come to a satisfactory conclusion, it must at all times be a question of fact with reference to all the circumstances of the case."

Nuisance by noise has frequently been dealt with by the Court. In 1868 an injunction was granted to prevent the use of a steam engine and circular saw. In 1871 the trustees of a Roman Catholic chapel succeeded in an action brought to restrict the use of a steam hammer which interfered with the devotions of those who attended the chapel. Coming down to late times, piledriving by night, which interfered with visitors at De Keyser's Hotel, was restrained by injunction in 1914. Again, in 1919, it was held that the noise caused by the manufacture of aeroplane engines, which interfered with the comfort of certain families in a residential district, "according to the ordinary notions prevalent amongst reasonable English men and women," was held to be an actionable nuisance. But in 1922 a man who complained of the crowing of a cock—it may be presumed he was not an early riser—was held not to be entitled to complain of a nuisance.

It is noteworthy that in the case of Soltau *v.* de Held (*supra*) the Vice-Chancellor draws attention to the interests of persons other than the man who actually complained of the bells; he pointed out that there might be others who actually enjoyed their sound. But there does not seem to be any case in which it has been held that the interest of the public generally is to be considered when the question is whether a noise shall or shall not be allowed to continue. It is manifest that there are some operations in manufacture which cannot be carried out without the creation of noise which reaches the ears of large numbers of persons. It is also manifest that certain noisy trades are of great importance to the community—nay, they may even be of vital importance, as, for instance, in wartime. That *some* attention must be paid to the public interest appears from a passage in the judgment of Lord Westbury in St. Helen's Smelting Works *v.* Tipping in 1862, where complaint was made of damage done by vapours, &c., from a smelting works. Although it was there held that the plaintiff was entitled to relief, owing to his property having been damaged by noxious vapours, the Lord Chancellor said: "If a man lives in a town he should submit himself to the consequences of those obligations of trade which may be carried on in his immediate locality which are actually necessary for trade and commerce, also for the enjoyment of property and for the benefit of the inhabitants of the town and of the public at large."

But there is no reported case in which any judge has roundly asserted: "The making of this noise is essential in the public interest, and therefore no action will lie in respect of it, whether it be described as a public or a private nuisance." Nor does it appear to be any answer to a complaint of nuisance by noise that the defendant has used the best known and most approved apparatus, and that his desired object cannot be otherwise attained. If a man who comes to break up the pavement outside my office window with a pneumatic drill makes a noise almost sufficient to wake the dead, it is no answer for him to say: "I can do it in no other way." The strict reply—of the lawyer—will be: "You must not do it *at all* if you cannot do it quietly."

But there is, and must always be, an element of reason in these matters. No man can reasonably object to the breaking up of streets. Yet if it could be shown that there was in existence some quiet method of breaking up concrete, the man who complained of the present method could make out a strong case for relief. It would be no answer that the silent method was more expensive.

Japanese Engineering Industries.

No. III.*

NIIGATA ENGINEERING WORKS, LTD.

In 1895 the Japan Oil Company, Ltd., founded works at Yamanoshita, on the outskirts of the city of Niigata, in order to make and repair the machinery and tools required for working the company's oilfields, as well as machinery for refining the oil product. The works were named after the city and became known as Niigata Tekkosho.

With the development of the oil industry the enterprise expanded, and the number of manufactured articles gradually increased, foreign markets being found for the company's products in Korea, China, and the South Sea Islands. By this latter phrase (*Nanyo Yumi* in Japanese) are not meant the Fiji and other groups far south of the Equator, but the archipelagoes far south of Japan, the Philippines, Dutch Indies, and Japan's mandated territories, and the Marshall and other groups on or north of the Equator.

In 1910 the works were separated from the Japan Oil Company and were incorporated as a joint stock company (*kabushiki kaisha*) with a subscribed capital of two million yen. In the following year the head office was moved from Niigata to Tokio, and the capital was increased from 2 to 5 million Yen.

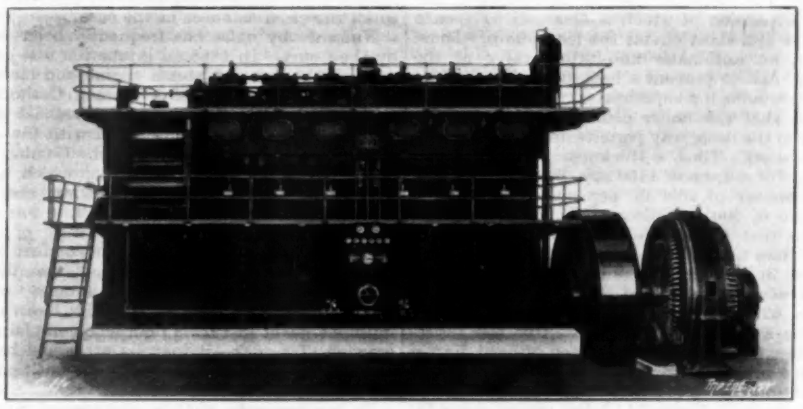


FIG. 19—2000 I.H.P. NOBEL-DIESEL ENGINE AND 1500-kVA ALTERNATOR

Disaster came in 1923, when the Tokio Works were destroyed by fire, which accompanied the great earthquake, the works being completely gutted, while the Kamata Works were also heavily damaged. The capital was reduced from five to four millions, fully paid up.

Niigata Engineering Works, Ltd., now controls the following :—The Kamata Works, near Tokio ; Niigata Works, the Kashiwazaki branch works at Kashiwazaki, and the Nagaoka branch works at Nagaoka. Of these, the Kamata Works are on the largest scale and are the best equipped.

THE KAMATA WORKS.

These works are situated in what until quite recently was open country and is now part of the vastly increasing area of the metropolis. They are adjacent to Kamata Station on the railway between Tokio and Yokohama, and, with ample sidings, have thus excellent facilities for railway transport. The shops and office buildings occupy an area of 3·61 acres, on land covering 19·45 acres. They were designed and built especially for the exclusive manufacture of Niigata-Diesel engines and are equipped with the most modern machinery. The works comprise an internal combustion engine department, machine tool department, and foundry ; in addition there are a heat treatment workshop and a laboratory for research. Recently, the machine tool department of the works at Niigata was removed to Kamata.

The internal combustion engine shop was constructed in 1920. In 1918 the company secured from Mirrlees, Bickerton and Day, Ltd., the right to manufacture in Japan the four-cycle Diesel, and subsequently several representatives of the company, including the chief engineer, other engineers and artisans, were sent to England to familiarise themselves with the design and manufacture of the patented engines as they are turned out in Manchester. The party returned to Japan in 1920, in which year the company started the manufacture of the specialty.

Particulars of Low Carbon Cast Irons.

Test number.	Total carbon.	Silicon.	Manganese.	Phosphorus.	Sulphur.	Tensile stress.	Transverse stress.	Brinell hardness.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Kg./sq. mm.	Kg.	
1	2·84	1·69	1·52	0·23	0·10	36·2	2250	241
2	2·84	2·23	1·98	0·19	0·06	37·2	—	240
3	3·03	1·79	1·37	0·38	0·11	40·0	—	245
4	3·13	1·59	1·75	0·24	0·05	36·4	2080	220

In 1924, with a view to making engines of larger type, the company acquired the sole right to manufacture a two-cycle engine from the Nobel Diesel Company, Ltd. To date, about five hundred Diesel engines, including four-cycle and two-cycle, with an aggregate capacity of 65,000 brake horse-power, have been placed on the market. The majority of Diesel engines for Japanese fishing boats have been supplied by this company.

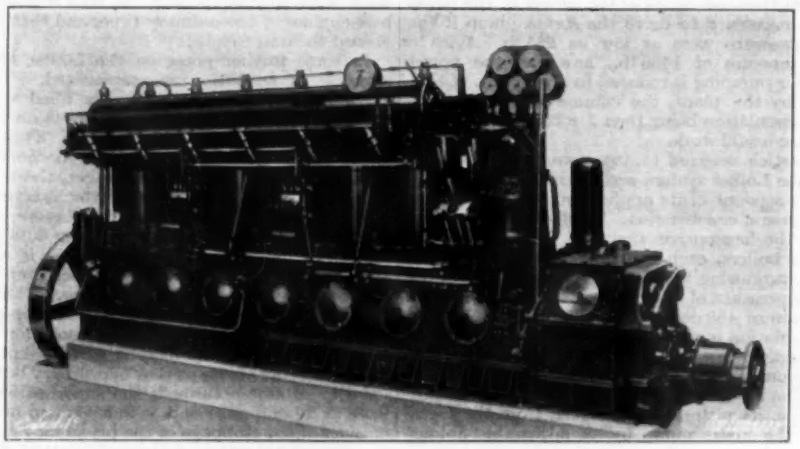


FIG. 20—250 B.H.P. 4-STROKE DIESEL ENGINE

The foundry produces a special low-carbon cast iron of the composition and characteristics of which are shown in the accompanying table.

The annual productive capacity of the works at Kamata is, for internal combustion engines, a limit of 20,000 brake horse-power, while the foundry is capable of producing 2500 tons of general cast iron and semi-steel and 100 tons of alloys.

The parent works in the city of Niigata cover an area of 35·8 acres, the shops and other buildings occupying 5·6 acres. The products there are valued at about three million yen annually, the manufactures being engines and boilers for marine and land use, steamers and sailing vessels, railway goods and passenger cars, oil tanks, air compressors, pumps, boring tools, dredgers and excavators. There are also a machine tool department, newly completed, and a slip dock of a capacity of 1000 tons.

Examples of the internal combustion engines made by this firm are shown in the accompanying engravings. Fig. 19 represents a six-cylinder Nobel-Diesel engine of the two-stroke, single-acting type for air injection. It has bores and strokes of 510 mm. and 760 mm. respectively, and it develops 2000 I.H P. at 150 r.p.m. It is coupled to an 11,000 volt, 1500 kVA. alternator, and it was built for the Niigata Hydro-electric Company in 1928. Fig. 20 shows a four-stroke Diesel engine for air injection. Its six cylinders have bores and strokes of 9·65in. and 10·24in. respectively, and it develops 250 B.H.P. at 550 r.p.m. The weight is 7 tons. In Fig. 21 is seen a small engine of the same type built for marine work. Its four cylinders have bores and strokes of 250 mm. and 380 mm. respectively, and it develops 150 B.H.P. at 300 r.p.m.

KASHIWAZAKI AND NAGAOKA WORKS.

The branch establishment at Kashiwazaki, in Niigata prefecture, specialises in rotary drilling machines for oilfields, oil refining machinery, oil tanks, engines and boilers, wax making machinery, pressure pipes, oil can making machinery, and hand and power-driven presses. The branch in the city of Nagaoka specialises in machinery and tools for the oil industry, engines and boilers, oil engines, papermaking machinery, pumps and pressure pipes.

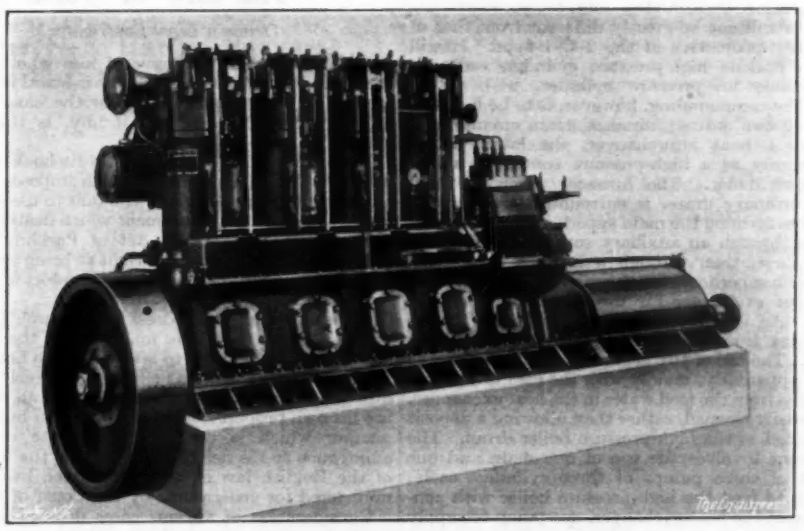


FIG. 21—150 B.H.P. 4-STROKE DIESEL MARINE ENGINE

* No. II. appeared November 1st.

Locomotive Repairs.

On Monday last Sir Henry Fowler read a paper on Locomotive Repairs at the Institute of Transport. The greater part of it was devoted to a description of the methods and organisation of the repair departments at the Derby works. Sir Henry showed on the screen the forms on which the shop and office records are kept, and exhibited several photographs of the ingenious devices which have been developed at Derby for accelerating the work. In a voluminous appendix to the paper he placed before the members of the Institute a complete and detailed account of the L.M.S. system.

The astonishing improvement effected by the new organisation in accelerating repairs is shown by the following table :—

	No. of Locos.	Per-centage.
1923	1958	19·02
1924	1856	18·11
1925	1375	13·47
1926	1345	13·24
1927	877	8·66
1928	605	6·13

The second column gives the daily average number of locomotives undergoing or awaiting repairs and the third their percentage with regard to the total stock.

These figures include engines undergoing heavy or light repairs at running sheds which are not directly under the supervision of the Chief Mechanical Engineer's department.

For the present year the improvement is even greater, for during the last week of September the daily average number of locomotives on the L.M. and S. Railway under and awaiting repairs was 464, or 4·7 of the total stock. We may perhaps remind our readers that 1923 was the year of railway amalgamation.

"Probably the most important work done on the mechanical engineering side of a railway is the maintenance of the locomotive stock in an efficient condition," said Sir Henry. In 1928 the four main companies of Great Britain owned 23,303 locomotives, and the total cost for maintenance and renewal was about £12,500,000. The reduction which is shown by the figures quoted above has been brought about practically entirely by improvement of organisation, and very little of it, we understand, by increase of the mileage between repairs.

The following passages are taken from Sir Henry's paper :

The number of locomotives (for the whole country) "under and awaiting repairs" at December 31st were :—1913, 3229, or 13·9 per cent. of total stock ; 1923, 4038, or 16·9 per cent. of total stock ; 1928, 2124, or 9·1 per cent. of total stock.

Probably these figures, more than any others, show the importance of the question under review. If the cost of a locomotive at present-day prices is taken at £3750, the idle stock at the end of 1928 represents £8,000,000, in spite of the great improvement brought about since the previous periods quoted. Any material improvement which can be made in these figures is therefore of the greatest importance.

One of the first essentials of rapid and economical repair is the standardisation of renewable parts, including the boiler, and it will be appreciated that, although since amalgamation 1494 new locomotives of nine standard types have been built for the London, Midland and Scottish Railway, there still exists a large number of classes which formed part of the stock of the various companies at the time of amalgamation. Naturally, the question of standardisation of individual parts, and particularly those requiring frequent renewal, has received special attention, but there are many of these which are not easy to arrange, owing to the relation they bear to other parts of the mechanism. The matter of this standardisation of parts is, however, one of the greatest importance, not only from the question of renewal, but also that if it is dealt with efficiently it leads to a reduction of the amount of stock to be held and consequent lowering of the amount of idle capital, whilst it allows the ready supply of parts required for replacement on engines at sheds or depôts. In addition, it also allows of the production in mass of the articles, with a consequent economy of manufacture. Against this has to be considered the question of when these considerations make it economical to scrap non-standard, though serviceable, articles, and this is a matter often requiring the most careful consideration.

The two points which first lead to an engine requiring "heavy" repairs are the boiler and the wheels.

The first of these, the boiler, is undoubtedly from every standpoint the most important part of a locomotive, and upon its design the efficiency of the locomotive itself largely depends. Its maintenance must be closely watched, so that any defect may at once be rectified, and at the same time it must be kept with its tubes free from dirt and its interior free from scale. The latter point is one of the greatest importance, for not only does its evaporative efficiency largely depend on this, but an accumulation of scale due to unsatisfactory water and inefficient washing out leads to repairs being much more frequently required. It is an interesting fact that north of the Scottish border boilers require much less frequent repairs, it having truly been said that, from a locomotive standpoint, there is no bad water in Scotland. The chief trouble with a boiler from a repair standpoint is the wasting away of the head of the copper stays in the fire-box. One is aware that there is probably a growing tendency to use a certain number of stays made of steel in locomotive fire-boxes, but, generally speaking, the stays are of copper. There is a Committee of the British Non-ferrous Metals Research Association sitting on this problem, and it is hoped that they will soon be able to report that they have made material progress. It is not proposed, however, to discuss the question here, the point being that it is chiefly the fact that the copper stay heads do waste away that causes a boiler to require attention.

With the wheels it is naturally the wear of the tires which determines how long they may run, and especially the contour of the flange. The author feels that here the angle of the inner side of the flange with the vertical should not be allowed to be too acute. The length of time that tires will run before requiring attention depends largely on the "curviness" of the road on which they run, and the tensile strength and hardness of the material of which they are composed.

Many years' experience showed that an increase in the life of tires of about 50 per cent. was obtained when the tensile strength was raised from 49 to 60–65 tons per square inch. One point which may be noted is that from a safety standpoint larger tires are often made somewhat softer than smaller ones. It is fortunate that usually roads on which there are many sharp curves are worked by engines having small wheels, and on these harder tires can be used.

The process of repairing a locomotive may follow one of three courses :—

(1) The whole of the repair may be carried out whilst the locomotive is in one position.

(2) The locomotive may, after being put on wheels, be moved forward on the same road at predetermined intervals on what is called the "belt system," as common in motor car erection and mass repair, and as employed by Henry Ford in the mass production of small ships during the war.

(3) The system by means of which the frames or locomotives are moved two or three times during the time they are in the shop.

The first method used to be the one most generally adopted in the past, and when coupled up with a system by which moving gangs of men carry out certain definite work, and whilst schedules were arranged for progressing the work, it gives fairly good results.

The second system has been applied successfully at the Crewe works of the London, Midland and Scottish Railway Company in the large new erecting shop built in 1926. It has been fully described by Captain Hewitt P. M. Beames in his paper before the Institution of Mechanical Engineers.*

The last method is the one employed at the Derby shops of the London, Midland and Scottish Railway Company.

It will doubtless, and naturally, be asked which method the author looks upon as the most efficient, and which he finds gives the best results.

This, as in so many other cases, depends largely upon the circumstances. The second method requires a somewhat larger shop and has advantages when a considerable number of locomotives of the same type or of closely similar types are to be repaired. This will readily be seen, as it will be appreciated that it lends itself to the provision of special tools, stagings, &c., which can be used and retained at the various points at which the engine stops on its journey down the shop. The daily move means that the completion of the work must be before this takes place. The third method has more flexibility, although it is as desirable here, as in the case just cited, that the moves shall take place at the arranged times.

In the remainder of the paper and in the appendices the Derby system is described in complete detail.

* "Proceedings," Inst. Mech. E., Vol. 1, 1928, pages 245–288.

Canadian Engineering News.

(From our own Correspondent.)

Manitoba's Water Power Resources.

While much is heard of the great water power developments in the older Provinces of Quebec and Ontario, it is not generally known that the Province of Manitoba is one of the richest provinces in Canada in water power available for development. The extent of these resources may be appreciated when it is stated that there is available on the various rivers a total of more than 3,000 000 continuous horse-power under conditions of ordinary minimum flow, and more than 5,000,000 continuous horse-power at ordinary six-month flow. At the beginning of 1929 the province had a turbine installation of 311,925 H.P. An enormous new power plant is under construction by the North-Western Power Company, a subsidiary of the Winnipeg Electric Company, on the Winnipeg River at Seven Sisters Falls. Here 112,500 H.P. is now being installed, with provision for increasing this to 225,000 H.P. later.

New Coalfield.

At Blacksmith Rapids, on the Abitibi River, in the Province of Ontario, a new coalfield has been located, one mile long and a half mile wide, and capable of producing, according to estimates, between 7,000,000 tons and 10,000,000 tons of good grade lignite. In the opinion of the Provincial Department of Mines, enough has been disclosed to warrant the discovery being described as the most important development in the mining field of the province in many years. The discovery comes after ten years of painstaking study and examination of the Abitibi area by Dr. W. S. Dyer, geologist, and other Mines Department officials. It comes on the heels of the completion of a 25,000 dollar diamond drilling campaign which the Government voted at the last session of the Ontario Legislature.

The Temiskaming and Northern Ontario Railway will, in all probability, be extended next spring to join its present terminus, Coral Rapids, with Blacksmith Rapids—some 30 miles—so as to tap the new found source of wealth. The Government has the matter under consideration at the present time. Systematic mining of the coal will be begun this winter, and diamond drilling will be prosecuted with even greater vigour. The Government will immediately establish a complete mining camp and sink a shaft at Blacksmith Rapids, so that sufficient coal may be mined this autumn for tests for domestic and industrial uses in the North, as well as on the Temiskaming and Northern Ontario Railway as fuel.

Steel Plant Extensions.

The Steel Company of Canada, Ltd., has just completed improvements and extensions at its Hamilton works. These extensions have been made to provide additional capacity to supply the growing needs of the country, and to replace equipment which has become uneconomical and obsolete as a result of the rapid strides made in the design of steel-producing facilities. The principal extensions are two new open-hearth furnaces, each of 130 tons capacity, a10in. and 12in. merchant mill, a cleaning and distribution system for blast-furnace gas, and a central pumping station for plant water supply. It is expected the new open-hearth furnaces will increase ingot production by 200,000 tons annually. The fuel used for melting and refining is a mixture of blast-furnace and coke oven gas, a new departure in North America, and these two furnaces are the first to be designed and built expressly for such mixed fuel on the Continent. They are completely equipped for automatic regulation. Regenerator chambers and flues are insulated to decrease the loss of heat through radiation, and auxiliary equipment has been designed and installed to reduce to a minimum preventable wastes and losses. Other accessories provided are hot metal ladles, each with a capacity of 70 gross tons of hot metal of an improved type, to convey molten pig iron from the blast-furnace to the open hearth department with minimum loss of heat ; a mixer for the storage of molten pig iron at the open hearth department until it is required for charging the open-hearth furnaces ; and an overhead crane of 100 tons capacity for transporting molten pig iron from the mixer to the open-hearth furnaces. A new charging machine has also been added. It picks up boxes containing several thousand pounds of material from railway trucks, inserts them in the white hot open-hearth furnace, turns them over and pours the material contained on the hearth of the furnace and finally returns them empty to the trucks. Another addition is a crane of 200 tons capacity, which picks up a ladle containing the entire heat of steel after it is discharged from the furnace and conveys it to the pouring platform, where the steel, still molten, is poured into moulds in which it solidifies into ingots.

In the new mill twelve stands of rolls are driven by six electric motors, with an aggregate capacity of 3700 H.P. Auxiliary motors for the operation of floor rollers, hot bed, furnace doors, shears, &c., number sixty-eight, with an aggregate horse-power of 1011. In the run-out tables, which convey the finished bar from the finishing stand of the rolling mill to the hot-bed, each of the 116 rollers is driven by an individual motor. The total number of motors installed in the mill is 190, with an aggregate horse-power of 4750. Approximately 90 per cent. of these motors are operated by three men.

A new central pumping station on the shore of Burlington Bay contains four centrifugal pumps with an aggregate capacity of 68,000,000 gallons a day. Provision has been made for the installation of further units should they be needed.

Nickel.

Illustrating the rapid advance in the use of nickel, the International Nickel Company of Canada reports that sales of nickel in the United States during 1928 were approximately 97 per cent. in excess of those of the previous year, and world sales of nickel, exclusive of the United States, increased approximately 52 per cent. The company attributes this expansion not only to generally good business conditions, but largely to new applications of nickel introduced through the efforts of its technical and sales organisations. Also a vast amount of nickel steel scrap accumulated during the world war has been consumed, and steel makers are consequently increasing their purchases of metallic nickel.

The merger in 1928 of the International Nickel Company and of the Mond Nickel Company has resulted in the mines and smelters of both companies in the Sudbury district coming under one control. Extensive plans for the increase of mining, smelting and refining operations are being rapidly pushed forward, and the capacity of the smelters near Sudbury and the nickel refinery at Port Colborne, Ontario, are being increased. A copper refinery and sulphuric acid plant are also being erected near Sudbury. The completion of this programme should result in a further large increase in the Canadian output of nickel and copper and of metals of the platinum group.

In addition to these operations, prospecting and development work is being done in the Sudbury district by a few independent operators. Foremost among these are the operations of the Falconbridge Nickel Mines, which has proved the existence on its property of large ore bodies, and is proceeding rapidly with the erection of a concentrator and a 200-ton smelter. Development is also being carried on by the Consolidated Mining and Smelting Company on its nickel-copper property at Rottenstone Lake, in Northern Saskatchewan, where an apparently important discovery was made in 1928. The Canadian production of nickel in 1928 amounted to about 48,400 short tons, as against 33,400 short tons in 1927, and these figures will probably be largely exceeded by the 1929 output.

Algoma Steel Extensions.

Extensions are being made to the 12in. and 18in. merchant mills of the Algoma Steel Corporation, subsidiary of the Lake Superior Corporation, at Sault Ste. Marie, Ontario. The new equipment, which will be entirely modern, is designed to meet the growing demand for this class of steel in Canada, and the company expects that the new business resulting from its installation will permit it to increase its output of steel by some 50,000 tons per year. In addition, the equipment will include modern re-heating furnaces, especially adapted to take care of the heating required for high-grade steels, such as alloys and forging steel.

One of the new features of the 18in. mill will be the installation of travelling tables, which will aid in speeding up production. There will be heavier motors and additional shearing and shipping facilities. In the 12in. mill there will be a new furnace, and a new roughing mill is being put in ahead of the present mill. In connection with this mill, a 9in. mill back of the present 12in. mill is being built, which will enable the plant to turn out smaller shapes, such as rounds and squares of $\frac{1}{4}$in., whereas $\frac{1}{2}$in. are the smallest shapes that can now be rolled. Another feature of the 12in. mill will be a modern automatic hot-bed especially designed for handling alloy steel. Additional shearing and shipping facilities will also have to be provided here.

Commercial Motor Show at Olympia.

No. II.*

It is perhaps not strictly correct to describe the present exhibition at Olympia as one devoted to commercial motor vehicles, for although they may predominate, there are also to be seen fire-engines, ambulance vans, agricultural tractors, taxicabs and street sweeping, watering and refuse collecting machines, none of which are directly associated with commerce, while there are trailers that are not self-propelling. It must, however, be admitted that the attractiveness of the Show is greatly enhanced by the great variety of uses to which the exhibits can be applied, for, generally speaking, there is little difference nowadays between the products of some of the principal exhibitors. Engines, gear-boxes, transmission mechanism, and the various details which go to make up the modern chassis have much in common; in fact, many of these parts are produced in the same factories.

In this review of the Show, therefore, we propose to confine ourselves chiefly to exhibits which possess outstanding characteristics rather than reproduce a catalogue of details and dimensions.

It should be mentioned that the number of exhibitors is considerably greater than that at the previous Exhibition, and that fact has necessitated a reduction of the space available for individual firms. This suggests a very prosperous condition in the industrial transport vehicle industry, and there is abundant evidence that "saturation point" in this branch of road transport has not yet been reached.

Karrier Motors.

Prominent amongst the exhibits of Karrier Motors Ltd., Huddersfield, is a combination vehicle designed for carrying heavy loads. This vehicle, which is illustrated in the engraving Fig. 9, above, and in Figs. 10 and 11, may be used either as a tractor and trailer, or as an articulated six-wheeler; but in either case up to 12 tons can be hauled by the provision of an auxiliary gear-box, which gives an additional 2·8 gear reduction. The whole vehicle, it is asserted, will turn in a 20ft. roadway without the necessity of reversing. For reversing as a tractor and trailer combination, provision is made for the trailer turntable to be locked, and the forward axle of the trailer to be lifted clear of the road by the operation of a pneumatic valve from the driver's seat, the conditions for reversing then becoming similar to those obtained with an articulated six-wheeler. When used as an articulated six-wheeler, the load on the rear axle on the tractor is sufficient to give the necessary adhesion for hill-climbing, and as a tractor and trailer combination additional adhesion may be obtained by the transfer of part of the trailer weight on to the driving wheels of the tractor.

FIG. 9 COMBINATION VEHICLE WITH 6-WHEEL TRAILER—KARRIER

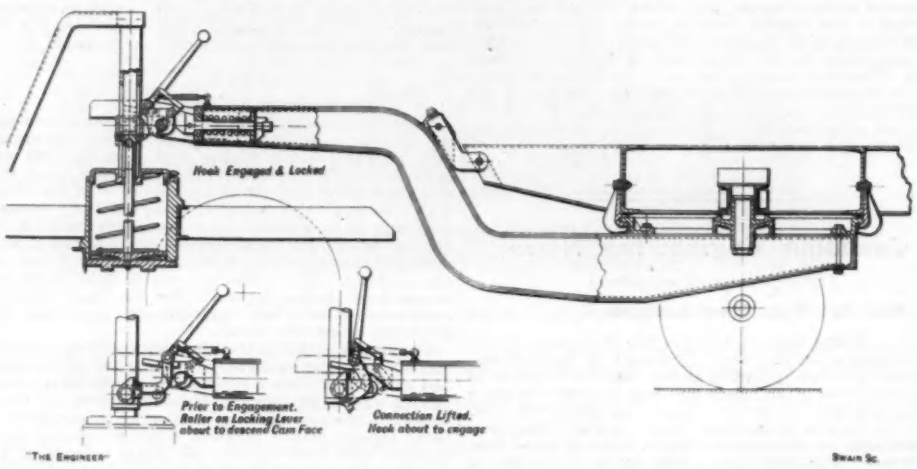

Hook Engaged & Locked
Prior to Engagement. Roller on Locking Lever about to descend Cam Face
Connection Lifted. Hook about to engage
"The Engineer"
Swain Sc.

FIG. 10—MECHANISM FOR COUPLING TRACTOR AND TRAILER—KARRIER

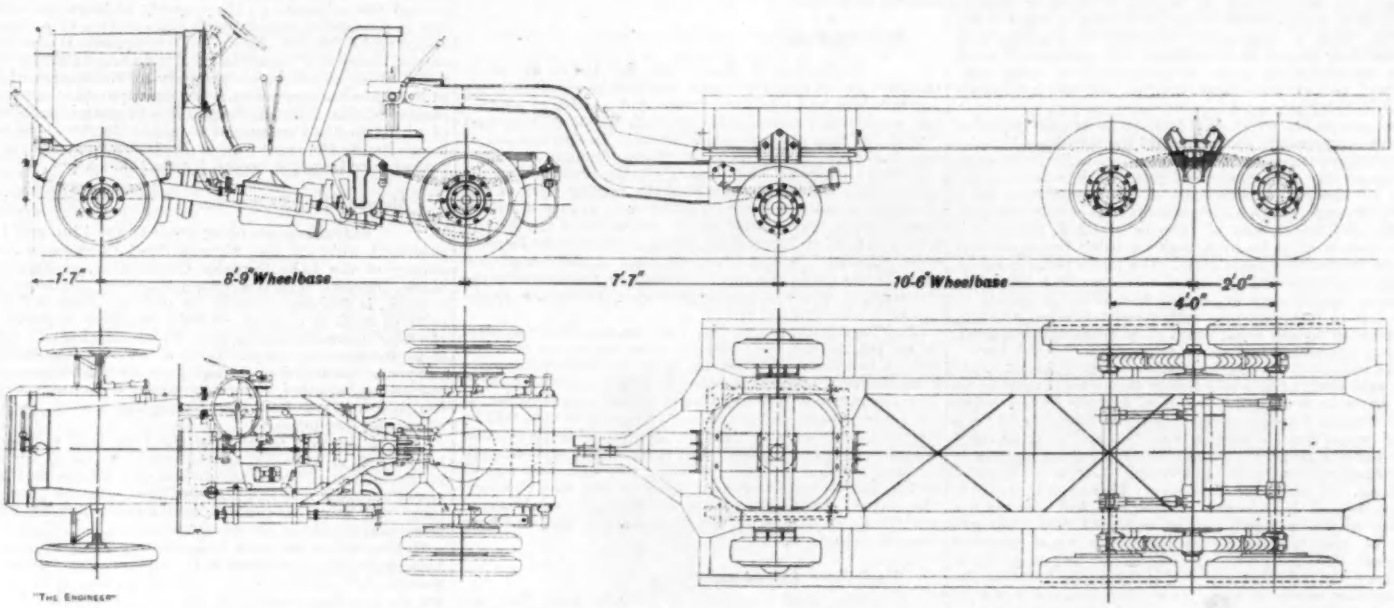


FIG. 11—SIDE ELEVATION AND PLAN OF COMBINATION VEHICLE AND TRAILER—KARRIER

The petrol engine has four cylinders, 95 mm. bore by 140 mm. stroke, and develops 31 horse-power at 1000 revolutions per minute. A combination of a cone and plate clutch transmits motion to a four-speed gear-box, with direct top gear drive. The gear-box is fixed in a sub-frame, which also carries the engine, giving correct alignment, and a subsidiary gear-box is bolted to the rear of the main box, with which it forms an integral part. A movable gear, operated by a lever on the driver's left hand, enables the low reduction referred to above to be obtained, and thus eight forward and two reverse speeds are obtained. The final transmission is by a short propeller shaft and two universal joints from the gear-box to worm gearing on the rear axle. Two independent brakes are fitted.

The hoisting gear is carried on the chassis frame forward of the rear axle and immediately behind the driver's cab. It consists of a pneumatic cylinder, 14in. diameter by 12in. stroke, on the head of which the hoist pillar is mounted. The arrangement is such as to allow either a portion or the whole of the weight on the trailer forward axle to be transferred to the tractor chassis. The control of this operation is effected from the driver's seat, a valve being opened until the transfer of the load is completed, when it is taken from the hoist pillar direct to the chassis frame. The necessary air pressure is supplied by a compressor mounted on the sub-frame and operated from the gear-box. The air is supplied to a reservoir carried at the rear of the tractor, from which it is directed by hand valves under the driver's control either to the trailer brakes or to the hoist cylinder. On the hoist pillar is mounted a coupler head for towing purposes, and the engagement of the spring-loaded hook carried on the swan neck of the trailer is automatic. The locking of the hook is also positive and automatic.

On the Karrier Company's stand is also shown a

the tractor may serve a number of trailers used individually and so reduce waiting time. Loads

* No. I. appeared November 8th.

petrol-engined chassis fitted with a gas-producing plant made by the Compound Gas Power Company, Reading. In this producer the makers claim that no hand blower is required for starting purposes. The products of combustion of the fuel-wood are taken through two grates of different size and are twice exposed to the heat of the fire, thus eliminating volatile matters and furnishing a dry, clean gas. The producer contains no moving parts, and as it has only one pipe connection is simple to apply to any ordinary chassis. The scrubber encircles the combustion chamber. As the suction through the producer is in a downward direction, it is possible to replenish the fuel while the plant is in operation. Fitted to a petrol-engined vehicle, the driving arrangements are simple, the foot accelerator being connected to the gas throttle valve.

Morris.

The firm of Morris has hitherto been associated exclusively with the manufacture of pleasure or private cars and light commercial vehicles. Henceforth it will have to be reckoned with in connection with the heavier passenger-carrying industry. The 28-passenger chassis exhibited at Olympia and illustrated in Fig. 12 has several features which are novel, and is in many respects a production worthy of a firm that has made a world-wide reputation. The outstanding features of the power mechanism are a six-cylinder engine—Figs. 13 and 15—with a great reserve of power and a high cam shaft arrangement, combining accessibility and simplicity; easy removal of the power unit; and quick detachment of the gear-box and clutch. The engine has cylinders 105 mm. bore by 135 mm. stroke, and develops 56 brake horse-power at 1000 revolutions per minute or 110 horse-power at 2600 revolutions per minute. The monobloc cylinder casting carries the cam shaft in an oil bath at the top, immediately below the head joint and alongside the cylinder barrels. The cams operate in an oil bath directly against rockers carried on the heads, the rockers acting, in turn, directly on the heads of the valves. No brackets are used to carry the rocker shafts which are bolted direct to the heads. Each shaft carries two rockers and is held in place by two nuts only. A detachable cover on each head encloses the rockers and valves, and allows access to the cam shaft. Each cylinder head block covers three cylinders, and the valve arrangement is such that either or both heads can be removed without the use of special tackle, and without in any way disturbing any part of the cam shaft drive or rocker gear. The heads carry all valves on one side inclined downwards and inwards, and entering hemispherical combustion chambers. The sparking plugs, exhaust, and inlet pipes are on the opposite side to the valves. The crank shaft has seven bearings, 2¾in. diameter, bronze backed, and lined with white metal.

The auxiliary driving gear casing is bolted to the front of the crank case. It contains a friction driven fan, dynamo drive and the water pump and chain adjuster, all of which run on ball bearings and are driven by a single ½in. pitch twin roller chain. On the fan shaft is mounted a gear wheel which meshes with a corresponding wheel on the cam shaft. It should be pointed out that all these units and the chain itself can be removed without dismantling the timing casing, while the cam shaft gears are accessible for inspection by removing a cover. The magneto is driven in tandem with the dynamo through a flexible and adjustable coupling, and its bracket can, if required, replace the dynamo bracket, thus allowing the use of the magneto without the dynamo.

The engine lubrication system has been well thought out, provision for filtration by means of a filter, which is easily removed, being made. The oil sump is bolted to the bottom half of the crank case, and can be easily removed for cleaning. The sump carries 4 gallons of oil, and is arranged in front of the engine, so as to get the full draught of the air. The necessity for frequent removal is obviated by a sludge trap, into which all oil is directed before passing through the suction filter. To prevent the flooding of the rear bearings when hill climbing, a scavenging pump is provided to draw surplus oil from the rear end of the crank case and feed into the main sump in front. The oil pumps are of the gear type, and are driven by skew gears from the front end of the crank shaft.

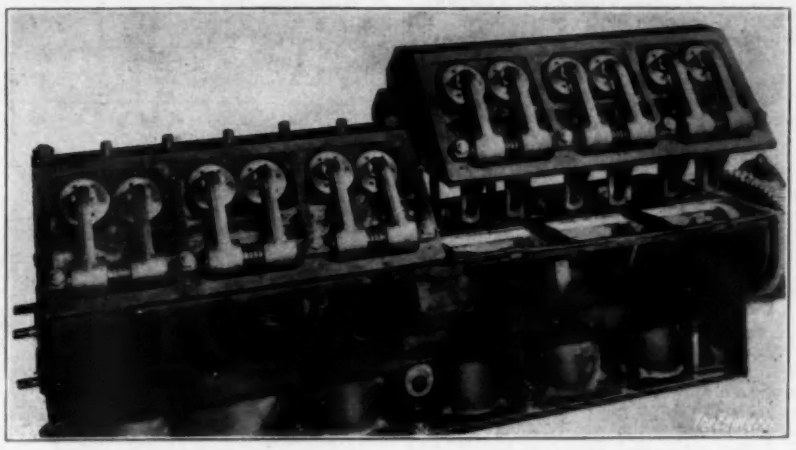


Fig. 15—Cylinder Heads of 6-Cylinder Engine—Morris

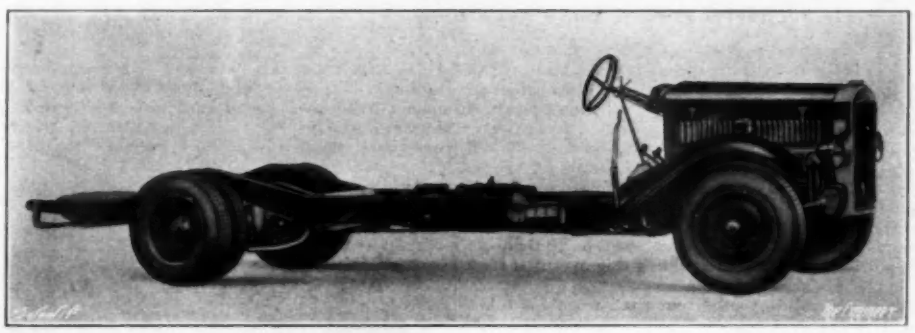


Fig. 12—Chassis of 28-passenger Vehicle—Morris

A simple means of removing the power unit is provided. The latter is carried on the front frame cross tube in a trunnion bearing, the tube also carrying the radiator. The tube is mounted on the two front frame dumb-irons. Two arms cast on the clutch housing carry spherical seatings which rest in seats formed in the front spring rear shackle brackets. These spherical bearings are spring-loaded to limit the stress on the engine casing in case of distortion of the chasiss frame. The four spring anchor brackets are held to the frame by set screws passing into inside blocks.

The removal of the engine and gear-box unit is performed by disconnecting the exhaust pipes, fuel pipe, and controls, disconnecting the side steering-rod and shock absorbers at one end of each, affixing a tail skid to the gear-box and removing the lid. Then, after removing the spring anchor bracket set screws, the main frame is jacked up on each side, and the whole unit, including the radiator, is run out on the front wheels, using the front axle and tail skid as a carriage. The clutch is a single dry plate with a facing, 4in. wide. The friction material is riveted to the fly-wheel and a heavy pressure plate, and between the two runs a saw-steel driving disc, split to prevent distortion. There are twelve springs to distribute the load evenly over the pressure plate. A four-speed gear-box and worm-driven rear axle of the underslung type form the transmission.

Long semi-elliptic springs are provided to give easy riding, and "silent bloc" compressed rubber bushes are used in all spring and shackle eyes. Luvax shock absorbers are provided to both front and rear springs. The electrical equipment includes a

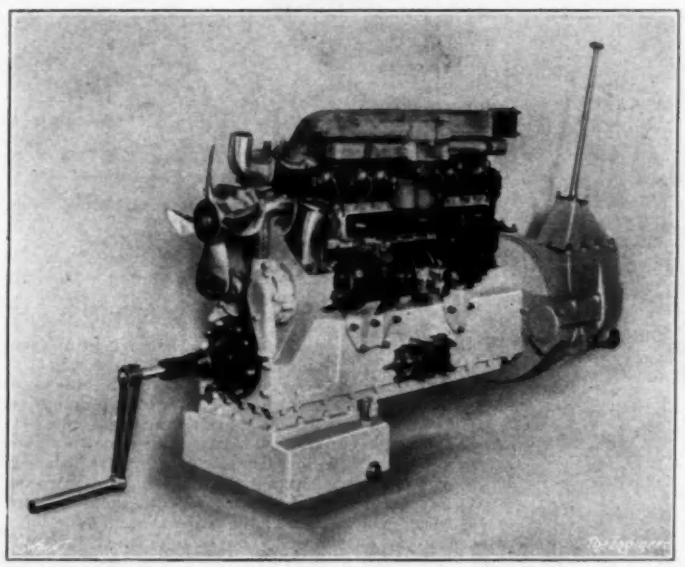


Fig. 13—56 B.H.P. 6-Cylinder Engine—Morris

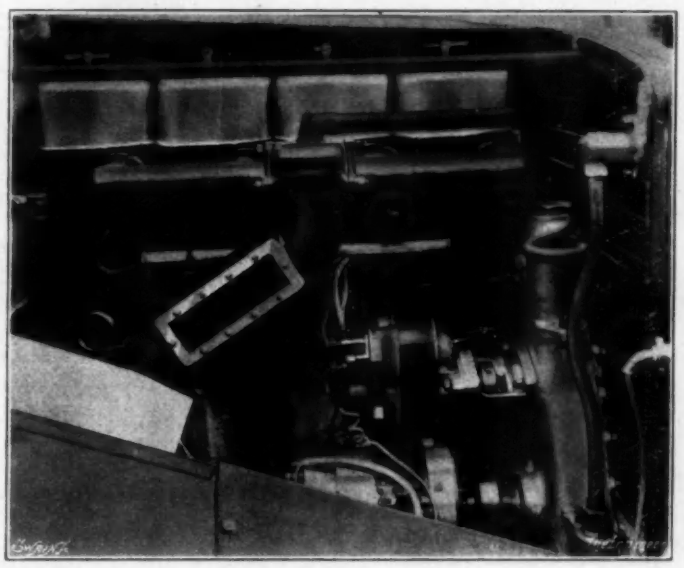


Fig. 14—Engine of 4-Wheel Drive Tractor—Armstrong-Siddeley

C.A.V. 12-volt dynamo of the voltage regulator type, and a C.A.V. starter with sliding pinion meshing with a fly-wheel ring. The petrol tank contains 35 gallons, and a 4-gallon reserve tank is arranged on the side of the frame.

Sentinel.

Five exhibits of steam wagons are made by Sentinel Waggon Works, Ltd., Shrewsbury, and include a 10/15-ton rigid six-wheeler flat platform wagon, a 12-ton six-wheeler, three-way tipping wagon, a 12-ton side-tipping wagon, and two lighter four-wheel wagons. All these machines are propelled by this firm's standard twin-cylindered engines, the bore and stroke of which are 6in. by 8in. respectively, with a two-speed gear and differential in an aluminium casing integral with the crank chamber, the final drive being by roller chain. The boiler is of the water-tube type, designed for a working pressure of 275 lb., and has a superheater and removable fire-box. On these vehicles the brakes comprise eight shoes operated by steam and eight operated by hand mechanism. The six-wheeled platform wagon has an important new feature in the form of a safety device designed to prevent the driver from leaving the tipping gear valve open when the wagon is running, and thus possibly throwing an excessive stress on the chassis frame and parts of the tipping gear. To guard against that occurrence an improved form of relief valve has been fitted on the delivery pipe connecting the feed pump with the tipping cylinder. This valve is controlled by a wire cable and lever, the latter being attached to the bunker casing in front of the driver's seat. When it is required to tip the body, this lever has to be moved into the vertical position, the result being that the driver cannot sit in the driving seat. He is thus automatically reminded that before he starts the wagon he should push the lever down into the horizontal position. When so placed, no pressure can accumulate in the tipping cylinder whilst the wagon is on the move, and no damage to the frame or parts of the tipping gear is possible. The capacity of the feed water tank has also been increased to 230 gallons. This quantity of water is sufficient for 50 miles, and is an increase of more than 25 per cent. on the former capacity of the tank. A further improvement consists of fitting caps to the ends of the hollow rear axle on which the oscillating bogie arms are carried. These caps prevent the entry of dirt or grit, and also retain the lubricant which is supplied by lubrication cups on the top of the outer casing covering the bearings on the axle and connecting the two arms on either side of the bogie. The rear ends of the radius rods, where they are attached to the forward ends of the bogie arms, have also been enclosed and fitted with lubricators.

Armstrong-Siddeley.

Two novel and interesting vehicles are shown by Armstrong-Siddeley Motors, Ltd., Coventry. They are a 45 horse-power, four-cylinder, four-wheel drive tractor and a reconnaissance car, both of the Pavesi type, illustrations of which are given in Figs. 16 and 17, and in Fig. 14, page 521. In each case the power unit

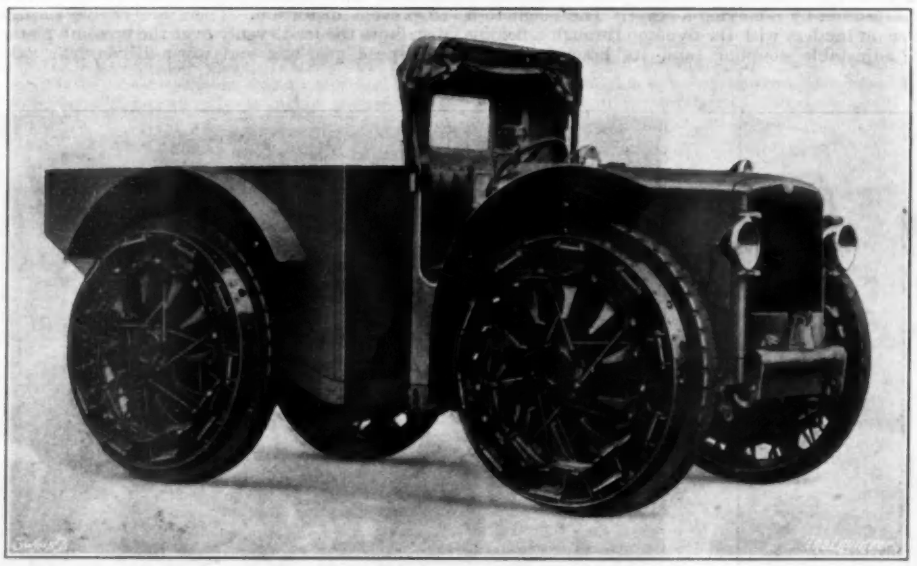


Fig. 16—Four-wheel Drive Tractor—Armstrong-Siddeley

consists of an air-cooled engine with cylinders 4in. by 4½in., which develops 45 horse-power at a speed of 1600 revolutions per minute. The ignition is by magneto and the engine is cooled by a fan, which is positively driven from the front of the unit, and draws air through an oil cooler at the front of the machine. The air then passes over the cylinder heads and around the cylinder barrels and is finally discharged from the fan through a duct between the frame and final drive gear casing. The dry sump principle of lubrication is used, gear type oil pumps being fitted to the bottom of the oil case. A dual scavenge pump draws oil from each end of the oil base, and thus scavenges efficiently at any angle of the machine, the oil being cooled by the cooling radiator at the front of the machine. Overhead valves are operated by rockers running on ball bearings, the whole being totally enclosed, and means being provided for rendering valve adjustment easily accessible. Starting is by electric motor fitted with a Bendix drive, which operates the enclosed fly-wheel, and the dynamo is gear-driven from the front end of the engine.

The gear-box is of the company's self-changing epicyclic type, giving four speeds forward and reverse and an emergency low gear and direct drive when on top. The gear-box forms a unit with the engine and the front cross drive. At the rear end of the gear-box a train of gears leads to a jack shaft, which is mounted on ball bearings and provided with means for taking the end thrust. The cross shaft drives by helical bevel gears to ensure quietness and smoothness of operation. The drive to the front wheels is taken through a differential gear which can be thrown out of operation by means of a sliding dog operated from the driver's seat.

The transmission to the rear road wheels is taken from the gear-box by a propeller shaft to the rear cross shaft through spiral bevel and differential gear wheels which are similar to those used for the front drive. The rear differential can also be locked by the driver when desired. A special feature of the machines is the steering gear. A tubular steering shaft operates a worm and wheel, the whole being mounted on ball bearings and totally enclosed. From the steering-box a telescopic shaft carried on universal joints connects with the final steering shaft, which is mounted on the central tubular member of the chassis. Finally, a helical gear engages with a large spur gear which, in turn, engages with the two steering racks—Fig. 18—mounted one on each frame member. Each frame is carried on two semi-elliptic springs of large proportions, these, in turn, being attached to the dead axles. These springs make for easy riding of the vehicle when crossing bad country, and save the transmission from severe shocks.

Both brakes are of the contracting shoe type and act indirectly on all four road wheels. They are mounted on the transmission, one behind the gear-box and the other just in front of the rear bevel pinion casing. The front brake is controlled by a hand lever, and the rear brake by means of a pedal.

On the tractor, a winch drum, positively driven by spur gears, is mounted on the rear cross shaft casing. The winch is thrown into operation by means of a sliding dog, which is controlled by a lever mounted at the back of the rear frame close to the door. Large spoked wheels with semi-solid tires are used on the tractor. The wheels, which are 51in. in diameter, carry steel strakes, which are permanently fixed to the rim and can be swung readily into position on the rim face for crossing soft ground by releasing a spring-loaded trigger.

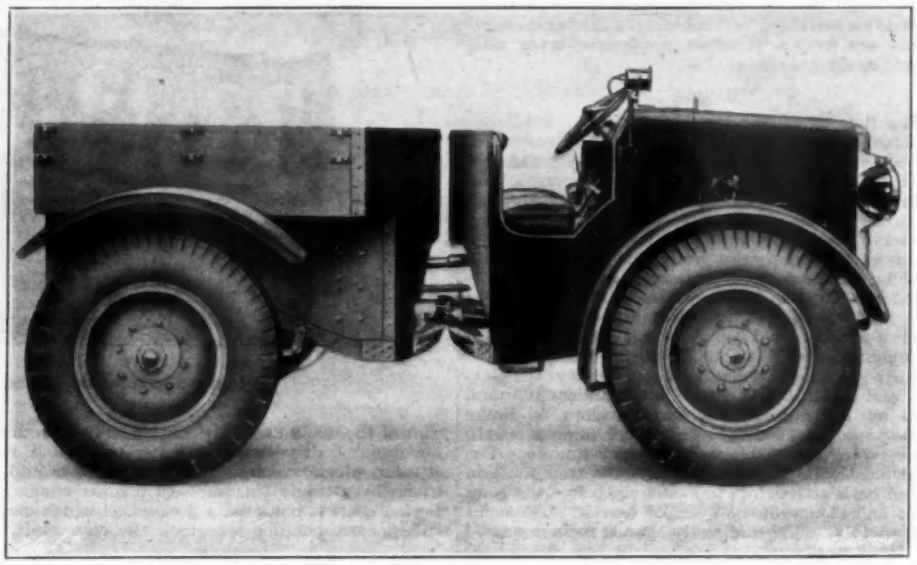


Fig. 17—Four-wheel Drive Reconnaissance Car—Armstrong-Siddeley

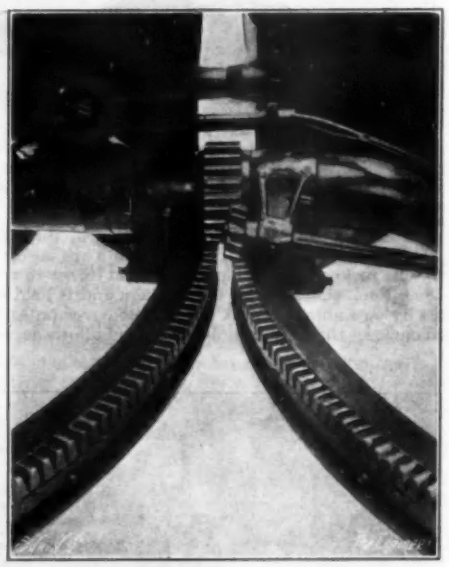


Fig. 18—Steering Mechanism of Four-wheel Drive Tractor

Yorkshire.

The outstanding feature of the Yorkshire Steam Wagon Company's exhibit of a six-wheel wagon with hydraulic three-way tipping body, is the original method of transmitting the power to the driving axles. It consists of a dual cardan shaft arrangement. There is a single cardan shaft from the engine to a central auxiliary gear-box from which two further shafts drive the worm gearing in the axles. These two shafts revolve in opposite directions, and there is a differential gear in each of the rear axles, and the lubrication is automatic. The double-ended locomotive-type boiler with its superheater arranged transversely across the front of the wagon remains a prominent feature of this firm's products. It has a heating surface of 70 square feet, and is constructed for a working pressure of 250 lb. per square inch. The engine is a vertical two-cylinder compound fitted with a double high-pressure intercepting valve, the cylinders being 4½in. and 7½in. in diameter and the stroke is 8in. It gives 70 to 100 brake horse-power, and is fitted with radial valve gear.

(To be continued.)

Railway and Road Matters.

THE Metropolitan Railway proposes to spend, under the Development (Loan Guarantees and Grants) Act, £500,000 on providing longer platforms at about ten stations, in order to allow for the lengthening of the trains and for the equipment of the remainder of the whole of its system with automatic signalling.

THE vacancy in the position of running superintendent on the Kenya and Uganda Railway has been filled by the appointment of Mr. J. G. B. Sams, who was a premium apprentice at Crewe, and later in the running department of the Great Eastern. In 1925 he went to the Jamaican Government Railways, and came home about a year ago.

THE electrical operation of trains on the Great Indian Peninsular Railway from Kalyan to Poona was officially opened by Sir Frederick Sykes on November 5th. From Bombay to Kalyan, a distance of 33 miles, the working has been in force for some time, and the extension to Poona will add another 82 miles. From Kalyan to Igatpuri will follow, and that will be a further 82 miles.

THE reception yard on the London and North-Eastern main line which corresponds with Willesden, Brent, Old Oak Common, &c., is at Ferme Park, between Harringay and Hornsea stations. It is about to be enlarged, at a cost of £70,000, mainly with the object of effecting the quicker supply of coal to London and the South of England during prolonged spells of cold weather.

THE main line to the west, *viâ* Westbury, of the Great Western Railway joins the original main line, *viâ* Bristol, at Cogload Junction, just north of Taunton. Immediately south of Taunton is Norton Fitzwarren, where are the junctions for Minehead and Ilfracombe. There are at the moment only two lines of way between Cogload and Norton Fitzwarren, and it has been decided to provide four roads throughout, which will include Taunton Station.

THE London, Midland and Scottish Company, as part of the work to be done under the Development (Loan Guarantees and Grants) Act, is to convert to electric traction the Tilbury line between Dagenham and Upminster. The Wirral Railway is also to be changed, and we assume that it will then be possible for the electrically operated trains of the Mersey Railway to work through from Liverpool and for the L.M.S. trains in the Wirral peninsula to run through the Mersey Tunnel into Liverpool.

THE Southern Railway Company was recently fined 40s. for permitting a locomotive to emit excessive smoke on Charing Cross Bridge. It was stated that dense black smoke issued from the engine for 13 minutes. The solicitor for the railway company complained that the London County Council inspector stood watching the engine smoke for 10 minutes, and if he had drawn the driver's attention to it there would have been no need for a prosecution. A momentary inattention by the man on the footplate might be sufficient to produce black smoke.

ACCORDING to a cable from its Wellington correspondent which appeared in *The Times* of the 7th, the Transport Bill mentioned on page 257 of our issue of September 6th last, is to be modified by the deletion of all the proposals, except that for the creation of a Ministry of Transport. The representative of the Government, in making this announcement, said that in view of the opposition to the Bill, which he believed was due to misunderstanding, the provisions for a comprehensive organisation for the co-ordination of transport would be deferred.

THE closing of St. John's Wood and Marlborough-road stations on the Metropolitan Railway during the morning and evening rush hours, referred to in our issues of August 9th and October 18th, has, after all, been modified in response to the protests by the travelling public. The *status quo* will be restored as regards the evening trains, but during the morning busy times the stations will be closed. That is done so as to increase the carrying capacity of the tunnel between Finchley-road and Baker-street by the four minutes or so saved by the trains not having to call at the two stations named.

As a passenger train from Musselburgh to Waverley Station, Edinburgh, was passing Piershill Junction, east of the latter station, on August 7th, it came in sidelong collision with a light engine, running tender first. The latter had been standing on the down slow line at the outer home signal, and its driver was studying the timing of an excursion train he had to work when he heard a signal arm lowered. Looking up, he saw a green light, which he misread as his, and gave his engine steam. The signal applied, however, to the down fast line, and was for the train from Musselburgh. He soon realised his error, but too late to avoid the collision. The accident was inquired into by Lieut.-Colonel Anderson, who remarks in the conclusion to his consequent report that the accident would have been prevented by an automatic train control device of the type which gives a brake application at the stop signal.

A MOTION in favour of the nationalisation of railways and long-distance road transport was discussed in the House of Commons on the evening of Wednesday, the 6th. In replying to the debate, Mr. H. Morrison, the Minister of Transport, said that the railway companies, the nation, the travelling public, and probably the employees in the transport undertakings were suffering to-day from the needless costs consequent on the high capital charges and high maintenance charges which the industry was carrying, owing to the fact that we had allowed our transport system to develop in a hotch-potch way without any coherent plan or systematic policy. Co-ordination was in the air and everybody recognised that it must come. The policy of the Government was to promote the co-ordination of transport undertakings, always provided that that co-ordination was in the public interest and would not place the community at the mercy of a private monopoly set up by statute. They should not be hard upon the railway officials and the railway companies. Let them not underestimate the difficulties they had had to go through. It was not the railway companies which were conscious sinners, so much as the system upon which they had worked. An amendment was moved, but it was defeated by 139 votes to 227.

Notes and Memoranda.

IT has already been established by the Ordnance Department of America that guns of up to 75 mm. can be produced by a centrifugal process. It is proposed to develop the process for larger guns.

AN article in the issue of the *Chemical Trade Journal* for November 1st gives detailed instructions for the treatment of bodily burns by means of a solution of tannic acid and corrosive sublimate, according to the recommendations of Mr. W. C. Wilson, of Edinburgh University.

IN the course of a lecture before the Geological and Mining Society, in Manchester, Mr. D. Coatesworth said that he considered the best place to put the detonator for shot firing in coal mining was at the back end of the last cartridge inserted in the hole, with the detonator pointing in the direction of the charge.

REPLYING to some remarks made during the discussion of a paper read before the Society of Chemical Industry, Mr. Noel Heaton said that he did not consider titanium white alone was equal to white lead for outside painting work, but if it were used with a proper vehicle a durable outside paint could be obtained. At the same time, the more experience he had the more he was convinced that the best results would be obtained by combination of pigments. That seemed to him the proper way to solve the problem of durability.

A NEW "needle" is to be built in New York, if the plans of the City Bank-Farmers Trust Company are carried out, and they have developed to the extent of clearing the site for the new building. It is intended to make this office building seventy-two storeys, or 925ft. high. The ground space occupied by the building has a frontage, according to a rough scaling from a published plan, of about 165ft., but the major part of the building will be scarcely 100ft. square. No hint is given as to the amount of floor space which will be occupied in the upper floors for general service purposes.

THE number of furnaces in blast at the end of October was 166, a net decrease of two since the beginning of the month, two furnaces having been blown in and four blown out. The production of pig iron in October amounted to 688,700 tons, compared with 664,600 tons in September and 543,600 tons in October, 1928; the production included 208,100 tons of hematite, 299,800 tons of basic, 133,400 tons of foundry, and 21,700 tons of forge pig iron. The October output of steel ingots and castings amounted to 889,800 tons, compared with 847,900 tons in September and 756,000 tons in October, 1928.

THE steel roof girders of a railway tunnel in New York needed strengthening on account of corrosion. They were 27ft. 6in. long and 2ft. deep. In order to effect the repair the bottom flange plates were cut away and their place taken by new plates. The new plates were fixed in place at one end by arc welding, and they were then heated to a temperature of about 100 deg. Fah. with torches. The heating expanded the plates by about 0·1in., and they were then welded on at the other end. It was estimated that the plates, when cold again, carried a dead load stress of 11,000 lb. per square inch.

COAL-GRADING committees were appointed in South Africa in 1923 under the Coal Act of 1922, which provides for the inspection and grading of coal intended for export or bunkering, and also the prohibition of exporting and bunkering coals which are liable to spontaneous combustion. The grading committees under the Act made their own regulations with regard to grades and procedure of grading. Under the regulations of the Transvaal Coal Grading Committee any colliery, in order to export or supply coal for bunkering purposes, has to apply to the Grading Committee for a grading certificate. The Grading Committee then instructs the official grader to examine and report on the coal of that particular colliery. The official grader, in turn, inspects and samples the working faces of the mine, and also takes truck samples of the coal leaving the colliery. After testing these samples for liability to spontaneous combustion and determining the grade of coal by analysis of the samples, a certificate is issued by the Grading Committee, stating the grade of coal and such other particulars as may be desirable. The coal from a graded colliery is periodically sampled when in transit from the mine to the port of export, and the certificate qualified, suspended, or even withdrawn, according to the values obtained from such samples. The Research Institute and Coal Bill will repeal this Coal Act of 1922, and provide for the establishment of a Fuel Research Institute to study and investigate the fuel resources of the Union, and to take over the responsibilities of the present Grading Committee.

IN the course of experiments in coal carbonisation now in progress at the Pittsburgh Experiment Station of the American Bureau of Mines, the need has developed for a material of high thermal conductivity for constructing heating flues. Resistance to oxidation at temperatures around 1100 deg. Cent. was also required. A high-chrome—chromium, 32 per cent.; carbon, under 0·25 per cent.; nickel, 6 to 8 per cent.—steel was recommended for the purpose, and this was used in cast form. In use, the flues were rapidly heated to 900 deg. to 1100 deg. Cent. and maintained at this temperature for five to seven hours, after which they were allowed to cool to room temperature, the time required being about eighteen hours. On account of the large quantity of heat stored in the refractory setting in which the flues were placed, and its high insulating properties, the cooling was slow. After ten heats under these conditions it was noticed that, while there was scarcely a trace of oxidation of the high-chrome steel, it had become very brittle and some of the pieces had cracked. Attempts to repair the cracks by welding in an oxy-acetylene flame only resulted in further cracking, and the metal was so hard that it could not be machined. It may be concluded, states Mr. J. D. Davis in a recent issue of *Chemical and Metallurgical Engineering*, that cast high-chrome steel is not an ideal material to use when the service required involves alternate heating and cooling in contact with flue gases. The embrittlement may be due to carburisation by carbon monoxide, and if excess air were maintained in the gases less embrittlement might take place. Resistance of the metal to oxidation is very high.

Miscellanea.

AN explosives factory is to be put up on the shore of Taihu Lake, near Wusih, China. Raw materials and power will be obtained locally. The cost of the plant is estimated at £350,000.

THE plant for the manufacture of "spun-iron" pipes by the de Lavaud process of the Stanton Ironworks Company is being extended so that an additional 15 miles of pipe can be produced every week.

THE new Forest Research Institute at Dehra Dun, India, was opened on November 7th. The Institute, which dates back for over fifty years, is claimed to be the largest of its kind in the British Empire, if not in the world.

IT is said that the Blackburn Rolls-Royce "Iris III.," which has just been launched at Brough, Yorks., is the largest all-metal flying boat made in Great Britain. She has three Condor engines developing 2250 horse-power.

IT is claimed that the suspension bridge which is being built across the Canyon, near Canyon City, Colorado, will be the highest in the world. It will be over 1000ft. above the stream bed, but will, of course, be founded on the top of the escarpments.

CONSTRUCTION work on the San Gabriel Dam in Colorado has been suspended on account of a report, by a committee, that the site of the dam would be unstable. The cost of the projected works has been put at 25,000,000 dollars, and already some 3,000,000 dollars has been expended on exploratory work.

DURING the first eight months of this year 4,443,350 motor vehicles, comprising 3,831,045 passenger cars and 612,305 trucks, were produced in the United States. This output shows an increase of 1,206,936 vehicles over the corresponding period of 1928. The export of cars is at the rate of 18·2 per cent. of the total production.

A GERMAN group, headed by the Gutehoffnungshütte and including Demag and the A.E.G., has, says the *Iron and Coal Trades Review*, secured a contract with the Turkish Government to erect iron and steel works and rolling mills in that country. The works are to be completed in two years, and payments are to be spread over five or six years.

THE B.B.C. announces that a contract has been signed for the building of the north regional broadcasting transmitter at Moorside Edge, near Huddersfield. A number of Midland and London contractors were invited to compete, and the successful firm is the Anglo-Scottish Construction Company, Ltd., which was responsible for the erection of the building at the London regional transmitter at Brookman's Park. The work will be carried out under the direction and to the specification of the Civil Engineer to the British Broadcasting Corporation, and will start immediately. The building will take about a year to complete, and the lay-out will be very similar to that of Brookman's Park.

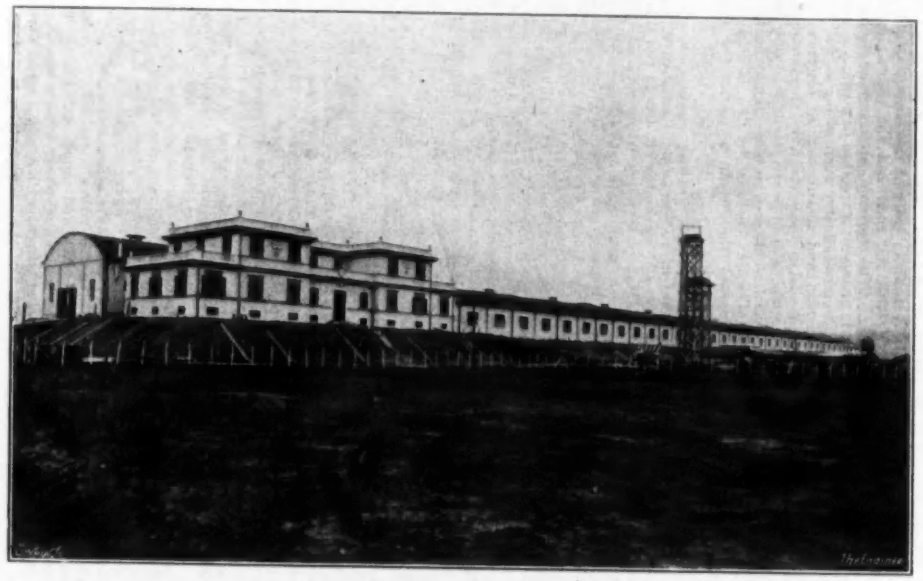
SPEAKING at Newnham recently, Mr. D. J. Vaughan said that the Severn barrage proposal was a commercial proposition. It would require national funds, and the cost would be from £20,000,000 to £25,000,000. The report on the proposal would not be available for another year, and when issued would have to survive criticism if not opposition from experts and interested bodies of all kinds. The barrage would be near the Severn railway tunnel; part of the barrage could, if necessary, carry both the road and the railway bridge over the Severn. The turbines at the barrage would provide electric energy at a fraction of a penny a unit, and would revolutionise industry even as far as the Midlands. The production and distribution of electrical energy would displace coal to some extent, but there would be compensating factors. Cheap power should lead to industrial expansion, which would provide more employment. The immense sheet of water enclosed by the barrage would attract industries to what would be one of the largest harbours in the world.

OXY-ACETYLENE cutting equipment was used with swift effect in the case of a lift accident which occurred on the evening of November 7th last at the Bootle factory of Messrs. Williams, toffee manufacturers. The accident involved the trapping of one of Messrs. Williams' workmen between the roof of the building and an angle iron of the lift, and the Bootle Fire Brigade, having been notified of that fact, immediately telephoned to Allen-Liversidge, Ltd., Stuart-road, Walton. One of that company's service demonstrators was sent off at once, with an assistant and cutting equipment, and he reached the scene of the accident a few minutes after the arrival of the Fire Brigade. The entrapped workman was quickly covered with sacking to prevent the sparks from the cutting operation igniting his clothing, and the demonstrator, Mr. R. Hughes, cut through the angle iron of the lift in a few seconds, thus releasing the victim. Mr. Smith, Chief of the Bootle Fire Brigade, afterwards complimented Mr. Hughes and Allen-Liversidge, Ltd., on the promptitude with which he and his company had answered the call for help.

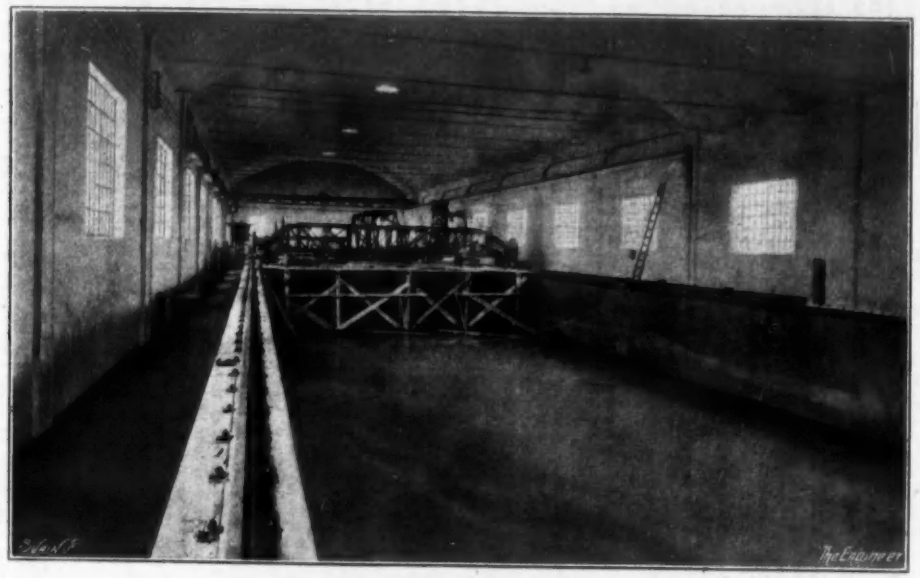
THE Dominion Bureau of Statistics at Ottawa, in its final report for 1927 on Central Electric Stations in Canada, records an increase of 20 per cent. during the year in the output by these plants. The total output in 1927 was 14,549,099 thousand kWh, as compared with 12,093,445 thousand kWh in 1926. The 1927 output was produced to the extent of 9,944,330 thousand kWh in commercial stations, the output of municipal stations during the year aggregating 4,604,769 thousand kWh. The number of central stations operating in Canada in 1927 was 629, capitalised at 866,825,285 dollars, having a total primary power equipment of 4,173,349 horse-power and a secondary power equipment aggregating 3,385,227 kVA. Of the 629 stations operating, 302 were hydraulic and 327 fuel-power stations. Commercial plants numbered 432 and municipal plants 197. Although the number of fuel-power plants was in excess of those producing current with water wheels, the primary power equipment of the hydro-electric plants totalled 3,975,012 horse-power, as against only 33,788 horse-power represented by steam reciprocating engines; 144,683 horse-power by steam turbines, and 19,866 horse-power by internal combustion engines.

NEW ITALIAN NATIONAL EXPERIMENTAL TANK AT ROME

(For description see page 516)



EXTERIOR VIEW OF TANK BUILDING AND ADMINISTRATIVE BUILDINGS



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THE ENGINEER.

NOVEMBER 15, 1929.

Economics and the Empire.

A PROBLEM which continually exercises economists and gives anxiety to industrialists is the disappearance of British foreign markets by the development of industries in distant parts of the British Empire. Not only have markets upon which we could once depend been lost, but in some cases the overseas manufacturer has become a competitor with the Old Country, even within her own boundaries—as, for example, when Canadian motor cars are sold in Great Britain or Indian iron enters a British port. It is as fruitless to protest against this state of affairs as to grumble about it. Every part of the Empire has a right to develop its own resources for its own advantage, and the Mother Country must frankly acknowlege the liberty of her sons to make their own living in their own way. But the effect upon Great Britain is already serious, and must become more serious in time. It is in part responsible for the permanent unemployed population of, in round numbers, one million people in this country. That surplus might be reduced if the far parts of the Empire could absorb a greater number of immigrants for the development of their industries, but that they are unable or unwilling to do at the present time. But they could help in another way. As we showed in a recent article in these columns, the only hope of reducing the fearful burden of unemployment is to be sought in improved trade, and for that improvement we may very reasonably look to the co-operation of the Dominions of the Crown. It is not suggested that they should make any sacrifice. On the contrary, there are many economists who feel confident that co-operation within the Empire would prove of material and industrial benefit to every unit of that vast organisation.

Amongst the protagonists of an organised Empire no one has been more active than Sir Robert Hadfield, who for many years has not ceased to urge the supreme importance of developing more actively the resources and potentialities of the British Empire, and well organised co-operation between Great Britain and her Dominions, Colonies, and India. He returns to this subject in an admirable article entitled "Economic Organisation and Development of Empire," in the November number of the *Contemporary Review*. In this article he insists upon the dual nature of the proposals which he has advanced—the development of all the resources of the Empire, and an Empire-wide economic federation for the benefit of all. "Great Britain," he writes, "has taken upon herself the great responsibility of Empire, and it is therefore our serious duty to encourage its economic development in the interests of the vast masses of people, white and coloured, who look to us to make safe the highway of economic leadership, and, above all, to guarantee future economic security at home as well as in the Dominions." With this exalted ideal of the nation's duties we hasten to ally ourselves. We have never felt the slightest sympathy with those who desire to limit the activities of the Dominions when they come into conflict with the industries of Great Britain, and we are heartily with Sir Robert in believing that the welfare of the whole Empire is to be sought in the perfect development of all its parts. "At present," to quote Sir Robert once more, "our Dominions are far too sparsely populated, and India and Africa's millions have a too low purchasing power to create an economic unit of Empire apart from the rest of the world. It is only by practical development of the resources of the Empire, India, and Crown Colonies that we shall ever approach an economic position of Empire independence as a unit." In other words, we must pursue in the Empire as a whole the same principle that we employ in the nation—the increase of its purchasing power by the prudent development of its resources. Our nation, Sir Robert continues, is suffering from semi-starvation in the midst of great wealth. "If," he writes, "our imperial resources were systematically developed, there would probably be an actual shortage of labour for all the new work required, instead of the appalling unemployment that exists at present, together with the unrest, low purchasing power, and economic insecurity amongst thousands of our people, not only at home, but in some of the Dominions." Sir Robert believes that to carry out his plan successfully it would be necessary for the British Empire to form an Imperial Development Fund of considerable magnitude and to set up an Empire Development Board. The services of this Board would not be continuous, but they would be more frequent than the meetings of the Imperial Conference. It is to be hoped that this suggestion, which is developed in a practical manner, will be carefully considered in all its aspects.

Napoleon sought by the force of arms to make a United States of Europe. He failed because any confederation of kingdoms held together by an overbearing power and lacking in reciprocal confidence is in a state of unstable equilibrium. Bismarck succeeded partially, and it is far from impossible that some still greater leader, wielding the ledger instead of the sword, will effect the amalgamation for industrial purposes of the principal states of the European continent. Clearly, Great Britain, with her vast empire, could not form part of that confederation. Yet if she remains alone she runs the danger of being crushed between the upper and the nether millstones—the United States of the New and the Old Worlds. In these circumstances, her obvious course is to amalgamate all parts of the Empire into a single federation. That enormous problems would have to be solved before that desideratum could be reached is beyond question. But we cannot bring ourselves to believe that the difficulties are insuperable, and we trust that at the approaching Imperial Conference a new attempt will be made to grapple with them. Once all are convinced that the interests of all can be best served by a common economic organisation, the will to effect that organisation will be created, and the realisation of it will not be long delayed. The article by Sir Robert Hadfield, to which we have referred, states the ideal to be aimed at as clearly as one can desire, and should do much to remove the misgivings of Dominions which fear the demand for sacrifices. What we all desire to see is a United Empire developing to the full the resources of its individual parts, but with a common object—the welfare of the whole.

A Terrible Future.

PEOPLE with post-futurist minds are always presenting us with visions of a frightful future. If they are high-scientists who find it difficult to talk in terms of familiar mensuration, but must for ever be thinking in stellar dimensions, they tell us that the world will last comfortably for another

200×10^6 years more or less, *if*—and they wrench us out of our feeling of security—some ultra-physicist does not blow the solar system to smithereens by inconsiderate triflings with particles of the order of magnitude of $2{\cdot}7 \times 10^{-8}$ cms. If they are philologists they threaten us with a universal language of no more than a few hundred grammalogues, some of them expressed in colours; if they are architects they curdle our blood with visions of a plastic future of uncontrolled exaggeration through the medium of cement; if they are poets they riddle our insides with samples of a percussive metre which is but a poor sample of what is in store for us; and if they are sculptors they tell us that the portals of Broadway House are crowned with works which are but the weak symbol and handsel of a future in which art shall be liberated from the trammels of the medium in which it works, and be able to express by the turn of a brush or the chip of the chisel a world—nay, a world is too small for them—a universe of profound thought.

There have recently come to our hands two little volumes in that ingenious series called "To-day and To-morrow." One of them, by Mr. H. Stafford Hatfield, bears the title "Automaton, or the Future of the Mechanical Man." It is a simple story—of a mechanised world—by comparison with the prophesies which, in the other, Mr. J. D. Bernal serves out to us—for all the world as though they were mere harmless parcels across a counter—under the heading "The World, the Flesh and the Devil." There is no "or" title to Mr. Bernal's book. Indeed, what alternative can any reasonable man ask for when he has all mundane life put before him in three short words. But let no man be deceived by a title which suggests so much; let no one think it is the sort of book you would not leave about in Victoria's days. Let no man believe even that it has much to do with any one of the three attractive entities which stand godfathers to it. As a matter of fact, it takes us out of the world into space, robs us of this poor flesh, and leaves no work for the Devil. If we may believe this uncomfortable prophet man is to escape presently, from an overcrowded planet in gigantic spheres which, like "human hearts," will float "midway betwixt earth and heaven." They will be ten miles in diameter, and being constructed of the "new molecular materials," will be free from gravity. Their substance will be drawn from "the smaller asteroids, moons, rings of Saturn, or other planetary detritus." The outer shell of these spheres will be hard, transparent and thin; it will permit the access of radiant energy and will have a protective and assimilative character. They will be dirigible, but meteorites which get in their path will be destroyed by firing high-speed projectiles into them, as mere terrestrial people dispose of water spouts. Such a radical change of environment calls for an equivalent change in our mortal frames. We shall have to be refitted for a new sphere. And what are we to become, dear brother? You and we who have managed to make shift, not without travail and sorrow, but still pleasantly enough with two legs, two arms—"mere parasites" our author calls them—a trunk full of oddments, and a head which can be used for thought when there is nothing better to do with it. What is to become of us? Listen to the author, for we dare not trust a matter so pregnant to our feeble pen: "Instead of the present body structure we should have the whole body framework of some very rigid material, probably not metal"—thank Heaven for that!—"but one of the new fibrous substances. In shape it might well be rather a short cylinder. Inside the cylinder and supported very carefully to prevent shock, is the brain with its nerve connections, immersed in a liquid of the nature of cerebro-spinal fluid, kept circulating over it at a uniform temperature." We are not surprised to learn that this astounding body will have its intestines outside. Nothing must be allowed to interfere with the brain floating in its cerebro-spinal fluid. The intestines would be "an elaborate automatic contrivance," fashioned in part from living organs. Now for the senses, of which the organs, being servants of it, are boxed up with the brain. "The eyes will look into a kind of optical box, which will enable them alternatively to look into periscopes projecting from the case, telescopes, microscopes, and a whole range of televisual apparatus. The ear would have the corresponding microphone attachments, and would still be the chief organ for wireless reception. Smell and taste . . . would be changed into chemical testing organs. . . . The remaining sensory organs . . . would go to the corresponding part of the exterior machinery." Perpetuation of the species is provided for without romance in an "ectogenetic factory"! The machine is a brain machine and nothing more; man ceases to be a corporeal body and becomes a thought. "This 'new man' must appear to those who have not contemplated him before as a strange, monstrous and inhuman creature, but, mark this, "he is only the logical outcome of the type of humanity that exists at present."

Is the last sentence the key to the author's meaning? Is he not really serious? Does he, himself, believe no more in his odious prophesy than we do? Is the whole essay a satire on a world composed for the one part of those who would mechanise it, like the author of "Automaton," and on the other of the "intellectuals," who affect to despise the body and seek for a cotton-woolly abstraction called pure thought? Observe how neatly all the parts fit into this conception of his meaning. Note the cylinder, the periscope, and other televisual apparatus. Might not this be a tilt at engineering and the paraphernalia of science. Consider also the divorcement of the functional parts of the body from the brain, and the absence of limbs, contemptuously thrown aside as "mere parasites." Does not this key-in with the sports-loving multitude who see only the body without a brain and the intellectual despisers of brawn who visualise a bodiless intellect? We cannot say if this be Mr. Bernal's intention. He writes with such seriousness and certainty of conviction that we cannot tell. But whether that be his intention or not, we shall all be the happier for taking it that way and be well rid of a nightmare which is no less dreadful because it is a phantasmagoria projected on a screen two million years away.

Obituary.

GEORGE FREDERICK CHARNOCK.

EVERY member of the Institution of Mechanical Engineers will be grieved to hear of the death of Professor Charnock, of Bradford, on November 7th, after an operation. For many years he was a member of Council of that Institution, came frequently to its meetings, and is the author of a paper which has been accepted for reading at an early date. He was a pillar of the Yorkshire Branch of the Institution, which was founded in 1921, and was its Chairman in 1924–25. He was also President of the Yorkshire Association of Students of the Institution of Civil Engineers in 1913–15, and first Chairman of the Yorkshire Association of that Institution in 1922. Furthermore, he was virtually the founder, and was the first President of the Bradford Engineering Society in 1899, and was its Secretary for many years. We mention these facts to show what a confirmed believer he was in the value of the work done by technical institutions. Indeed, his whole career was marked by unceasing efforts to bring science and technology into contact with practical commercial engineering. As a professor, his policy it was to keep himself well informed as to local industries, and hence he was able to train students at Bradford Technical College to fill the direct demand of the engineering firms of Yorkshire. It is interesting to note that after he became head of the Engineering Department of that College, 40,000 commercial tests were carried out under his direction.

Professor Charnock was born in Leeds sixty-nine years ago, and received his technical training at the old Yorkshire College, now Leeds University. In due course he became pupil and later assistant to Mr. H. P. Holt, M. Inst. C.E., consulting engineer, of Leeds. Subsequently he entered the service of Sir Charles Fox and Sons, of Westminster, and was engaged upon the construction of the West Lancashire Railway between Preston and Southport. In 1883 he was appointed chief assistant to Professor J. H. Dales, first Head of the Engineering Department of Bradford Technical College, succeeding him a few years later, and in 1904 was appointed Professor of Engineering. His range of interests was remarkably wide, as may be judged from the fact that he has left at the College a collection of no less than 10,000 lantern slides accumulated from his lectures in various branches of engineering. Of late years he specialised in mill engineering, and lectured to firemen on smoke abatement and kindred subjects. Indeed, he established special courses for them at Bradford and Huddersfield. He was the author of two well-known works, "Mechanical Technology" and "Graphic Statics." He was an excellent German scholar.

He will be remembered by all who knew him for his cheery personality and for a very remarkable knowledge, almost entirely gained by direct experience, of the practical problems of mechanical engineering. As he was blessed with a very retentive memory, he was never at a loss to illustrate any point that might arise in conversation from actual facts. As an admirable example of the professor who combines high scientific attainments with great technological knowledge his loss will be greatly felt.

Literature.

Industrial Storekeeping, Accounting, and Perpetual Inventory. By C. HANNEFORD-SMITH. London: Gee and Co., Ltd. 1929. Price 8s. net.

UNFORTUNATELY, it has almost become an axiom that when it is essential to reduce the cost of manufacture, the problem must first be approached by a close scrutiny of the wages involved, and too often the manual worker has been expected to accept a lower rate of pay. This mental outlook is frequently reflected in the many books devoted to factory administration, and a great amount of valuable space has been occupied with different schemes of payment, most of which are known by heart by the management. Yet, speaking broadly, the value of the materials used in the normal product of an engineering works is about the same as the wages expended in fashioning them to the finished article. Accordingly, we welcome a treatise, the avowed object of which is to save waste of material by a well-considered scheme of storage and stores control. As the author justly says: "When capital is in the form of cash it is carefully protected; . . . but once this capital is converted into materials, there is a tendency to become lax, . . . to tolerate practices that are wasteful, inefficient, and needlessly expensive."

The subject is handled in a systematic and concise manner, and the different possible sources of leakage are examined and safeguarded. Naturally, the general lay-out and position of the stores claims first attention—Chapter I.—and the author raises the question of the subsidiary store. In a large organisation, one central store becomes impracticable, and too often departmental stores are set up under the control of the shop administration, with the result that, frequently, there is a duplication of stock. We are in complete agreement with Mr. Hanneford-Smith when he maintains that all subsidiary stores should be placed under the supervision of the storekeeper for the entire factory. The idea of allotting a code number to each material is a sound one, yet the suggestions made would only prove suitable for a concern handling but a small variety of materials. When the variety is great, a more elaborate system would have to be evolved, based on a definite plan, whereby the code number would give an indication of the quality and size of the articles. Dividing materials arbitrarily into three categories, manufacturing, repair, and expense, cannot be recommended. One material might well come under two headings.

Purchasing, though not strictly part of storekeeping, is considered—Chapter II.—and the operations of the buyer's department are clearly indicated. We are told that "the storekeeper of a large concern is generally held responsible for requisitioning indirect materials," but we cannot help feeling that it is better that the management should denote those materials that are in constant and regular use, fixing a minimum stock; the only duty of the storekeeper would then be to maintain stock of these items. The term "indirect materials" is not definite enough, and there appears to be no valid reason for imposing a limitation of the sort.

Stores Routine and Accounting—Chapter III.—cannot be discussed without an appreciation of the duties and responsibilities of the storekeeper, and the author summarises these under eight different categories, most of which we should be prepared to accept. On one point, however, we must disagree. It does not seem reasonable to ensure a continuous check on stores by the storekeeper counting and comparing stock against bin card entries. It seems asking too much to expect the custodian of the goods to reveal an excess, which he will probably retain against a "rainy day," while a deficit might lead him into trouble, and he would be tempted to resort to the Micawber attitude of "waiting for something to turn up." Periodic checks are invaluable in keeping the storekeeper up to the mark, but he himself should not take them.

The method of fixing the price of stores—Chapter IV.—receives careful consideration, and four distinct practices are instanced, viz.:—(1) Average purchase price; (2) actual purchase price; (3) current market price; and (4) highest purchase price. Apart from dismissing the last one in a few words as generally impractical in that it tends to make quotations unduly high, the only point in its favour being precaution, the author does not express a preference for one of the remaining three, rightly stating that each has inherent advantages and drawbacks. The decision must largely be governed by the nature of product and local conditions. In any case the reconciliation of stores accounts with financial accounts must be ensured.

In dealing with the question of perpetual inventory and stores control—Chapter V.—Mr. Hanneford-Smith sketches the organisation of a stores department, and broaches the vexed question of the controller—shall it be the buyer, the secretary, or the works manager? We should like to have seen a definite pronouncement made, for we feel that the buyer will be best employed in devoting all his energies to the purchase of goods, leaving their storage and distribution to another official. The number of big organisations which adopt this policy is certainly on the increase. The centralisation of stores and store-

keeping is essential, even if physical centralisation is impracticable. A perpetual inventory, *i.e.*, a record of each item of material showing at least the quantity of materials received and disbursed, and the balance held, is such an asset as to be virtually a *sine qud non*, but again we must emphasise the necessity for taking this out of the control of the storekeeper. The time lost by an annual stocktaking has been unduly laboured, particularly as the practice of an annual holiday is rapidly developing.

Modern methods for Recording Stocks—Chapter VI.—are described fairly fully, four well-known systems being treated in detail and well illustrated.

The naming and numbering of the forms appear to be misleading, forms 15 and 16 are identical, the former merely the skeleton and the latter the same but with specimen entries. Form 18 bears the same name, although indications point to its being a separate form, a record kept by the cost department of quantities only, to enable stocktaking results to be checked. If this reading be correct, this particular form is redundant, as the results of physical stocktaking can be compared with bin card "remain," and the remain shown on the store record card.

We are surprised that no adequate reference has been made to the part that can be played by the application of machinery in stores accounting, without which the cost of a modern system of stores accounts and control would be prohibitive. This we mention, as well as criticising the forms, not in any way to detract from a very useful book, but rather to make future editions still more valuable.

Note sur les Connaissances actuelles des Propriétés de la Vapeur d'eau. By M. D. Sochaczewer. Extract from the *Annales des Mines*, May and June, 1929. Paris: Dunod. 1929.

Except for the publication of fresh knowledge, there is perhaps no more useful contribution to the literature of any controversial subject than a synthesis and comparison of the views held by various authorities. The need for such a summary is most acutely felt when, as in the case of the properties of steam, the evolution of knowledge is so rapid that the ordinary man has difficulty in keeping pace with the trends of opinion. The task of the author who would satisfy the need is, however, one of difficulty. He has no trouble in collecting figures and opinions; indeed, the multiplicity of the former produces a superabundance of the latter, but if he presents them impartially he must give equal prominence to those of very different weight and credibility, while if he shows any predilection he runs the risk of endorsing something which may be entirely discredited to-morrow. In the book before us, Monsieur Sochaczewer has given, for the benefit of French readers, a condensed account of the methods and results of the most important recent investigators of the properties of steam. His work was possibly all the more necessary because, since the classic determinations of Regnault, almost the whole of our knowledge of steam has been due to physicists writing in the English and German languages. The book opens with a chapter summarising the work of Regnault, followed by chapters dealing with that of the American Steam Tables Committee, of Knoblauch, and of Callendar, in the order given. Then come references to the "interpretation" of results in the production of tables and diagrams, as Mollier employed those of Callendar, Schüle those of the Reichanstalt, and as Eichelberg formulated the experimental data of Knoblauch in a manner which served as a basis for the diagrams of Stodola. Up to this point, the author expresses few opinions of his own and makes few comments, though in saying that "l'hypothèse de Callendar, que C_{p_0} est constant, ne s'accorde pas avec les essais de Munich et de Harvard," he is less than fair to the British physicist. What Callendar actually said in his book on "The Properties of Steam," published in 1920, is: "The value of S_0 is variable to a slight extent with temperature," and "it has been found possible to represent the properties of steam satisfactorily up to a temperature of 400 deg. Cent. by adopting a suitable mean value for S_0. This appears to be justifiable, because the uncertainty of the variation of S_0 over this range, according to different experiments and formulæ, is nearly of the same order of magnitude as the variation itself." The expressions C_{p_0} and S_0 both refer, of course, to the specific heat of steam at zero pressure.

When Monsieur Sochaczewer sets himself to appraise the relative value of the work of different investigators and to pass an opinion on the reliability of their results, he enters on very controversial ground. He graciously admits that Callendar's work is more exact than that of Regnault, but considers that, at the moment, the determinations of Knoblauch and his collaborators are the most correct which exist. He adds, however, that so far as one can judge the final results obtained by the American Steam Tables Committee are likely to be more exact still. Monsieur Sochaczewer has, of course, the same right as anyone else to hold what opinions he likes. But for him to say that "La méthode de Callendar est analogue à la méthode américaine," not only stretches the meaning of the word "analogue" to the breaking point, but would seem to imply that Callendar's work, commenced in 1895, was preceded by the work of a committee formed in 1921. Except that the A.S.M.E. committee has recognised the importance of the information given by the Joule-Thomson effect, as well as the necessity of thermodynamic consistency in its tabulations—both first emphasised by Callendar—its methods differ from his in almost every detail. Callendar is finally disposed of by the assertion that his method is "donc théorique," and that the small range of his experiments does not allow them to be considered as a sufficient basis for a complete steam table.

It is only fair to the author to note that in the final paragraph of his book he states that he completed it in September, 1928. It was in that same month that a reprint of Callendar's "Steam Tables and Equations extended by Direct Experiment to 4000 lb. per square inch and 400 deg. Cent.," presented the previous month to the Royal Society, was in the hands of engineers in this country. The title alone would have been sufficient to refute Monsieur Sochaczewer's complaint as to the inadequacy of the range of Callendar's experiments, while the extraordinary confirmation of his equations by experimental results at very high pressures, might have induced our author to admit that there was more in Callendar's methods than he had thought. As our readers will remember, these experiments proved that Callendar's simple equations for adiabatic expansion, for the total heat of water, and for the total heat of steam, held good without any modification right up to the critical region, while his general equation of state, when the higher degrees of molecular aggregation were taken into account, also represented the critical phenomena satisfactorily. Callendar further announced, at the same time, another discovery of great physical importance, namely, that the latent heat of steam persisted well beyond the critical temperature, where, according to previously accepted theories, it must necessarily vanish. The author concludes by expressing his intention of discussing later on the results of investigations published subsequently to the appearance of his book. We feel sure that when he does so, the work to which we have alluded will cause him to appreciate more truly the labours of a physicist whose name must rank with that of Regnault for insight and experimental skill in determining the properties of steam. Meanwhile, the present little volume cannot fail to be interesting to all who are looking for a brief account of the various methods employed and the different results obtained by men attacking a problem of extreme difficulty.

A Reference Index of Technological Literature. Mededeelingen van het Nederlandsch Instituut voor Documentatie en Registratuur. No. 6, 1928. Amsterdam: Nederlandsch Instituut voor Efficiency. 4to. Bi-monthly. £2 10s. per annum.

The indexing of scientific and technical literature is rapidly becoming recognised as a science in itself, not less important than efficient abstracting. The publication under review is of international scope and covers a wide range of the periodical literature devoted to applied science, technology and industry, and especially to engineering. The current annual volume comprises some 16,000 entries, printed in typescript upon one side only of each page, in double column. The entries can thus be cut up and mounted on cards for intercalation in a card index, or, alternatively, the sheets, which are bound on the loose-leaf system, can be filed as a whole under the first number on the page. The references are minutely classified according to the universal decimal code of the International Institute of Bibliography, which is now becoming recognised as the standard international classification for periodical literature. In addition, the names of the main classes are printed at the head of each page, so that familiarity with the international code is not essential to the use of the index. As a further convenience, the boundaries of each class are denoted by dotted lines, although each reference in the group is provided with the appropriate class number. Thus the references, if cut up, can be intercalated in order in any existing set of similarly classified references without further addition.

The index is undoubtedly an essential part of the equipment of any organisation engaged in technological or industrial investigations requiring a reference to current or past literature of this type, and its use is by no means restricted to those who already employ the decimal classification, although it is naturally of even greater value in their case.

Unfortunately the printing is not good, owing to the poor support afforded in the past to a laudable work. It is hoped that the increasing attention now being paid to efficient methods of subject-indexing, and the decimal classification in particular, will result in the necessary increase in the circulation of this publication to enable it to be produced in a style more in consonance with its undoubted value as a permanent bibliography of technical literature.

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The Balancing of Oil Engines. By W. Ker Wilson, B.Sc., &c. London: Charles Griffin and Co., Ltd., 42, Drury-lane, W.C. 2. Price 25s. net.

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Cable Research Handbooks: Vol. I., Rules, Regulations and Specifications Affecting the Supply and Distribution of Electricity. London: Commercial Secretaries, Ltd., Imperial House, Kingsway, W.C. 2. Price £1 1s. net.

SIXTY YEARS AGO.

In last week's issue we mentioned that sixty years ago Blackfriars Bridge across the Thames and its companion work, the viaduct across Holborn Valley, had just been formally opened, with a considerable display of ceremony. The bridge was hailed as a successful, artistic and noble work, but the viaduct, within three days of its being brought into use, began to show signs of decrepitude. In our issue of November 12th, 1869, we recorded that at the moment of writing a freezingly cold evening, crowds were assembled in Farringdon-street, eagerly gazing at the splintering bases of the granite columns on which the viaduct was supported. It was boldly asserted in the daily Press that the column bases were overloaded and were being crushed under the weight of the structure which they were called upon to bear. We totally disagreed with this view. We pointed out that each of the twelve columns was by itself almost sufficient to bear the entire passive and moving load of the whole structure, assuming that load to be applied truly vertically and to pass through the axis of the column. We further pointed out that the girders of the three cast iron arches composing the viaduct were so bolted together into one unit that if the columns could be taken away the structure would almost stand self-supported on its abutments. The splitting and spauling of the granite bases was, we contended, evidence that a grave error had been committed in the design of the viaduct. The fact that the girders were substantially continuous across the three unequal spans constituting the viaduct had, we said, resulted in the loads on the columns being applied with the line of pressure displaced from the intended axial direction. This fact was not, however, the only cause of the trouble. No freedom had, it appeared, been allowed for contraction or expansion of the girders. The viaduct had been erected in the warmth of the summer of 1869. The temperature had now fallen to the freezing point. This reduction of temperature had, we argued, acted cumulatively to increase the divergence of the pressure on the columns from the true vertical direction. The columns had been made, from some mistaken idea of artistic appearance, hexagonal in section. Had they been circular they might, we suggested, have borne without complaint their unfair treatment by the engineer who had designed the structure. The viaduct, we contended, had not been irreparably damaged so far. If prompt action were taken it might readily be saved. We suggested that the remedy lay in freeing the columns of rigid connection with the superstructure and in placing supporting balls or spherical knuckles between the capitals of the columns and the ironwork above.

Creep of Steel under Simple and Compound Stresses.*

By R. W. BAILEY.

THE degree in which the characteristics of a metal are permanent is a matter of considerable importance in determining how far working temperatures may be raised. Very little experimental evidence has been presented upon this point and most long duration tests have been made without any attention being given to the initial and final conditions of the metal, or whether any other changes than of dimensions were in progress. An examination of parts that have been in service under known operating conditions can throw useful light upon this matter. A good example of the changes that may take place in carbon steels under present initial steam temperatures is furnished by a superheater tube, where, owing to the different wall temperatures existing along its length, the progressive changes in structure may be examined.

Working conditions and particulars of the tube were as follows :—

Steam pressure	195 lb. per sq. in. (gauge)
Steam temperature	340 deg. Cent.
Dimensions of tube	1·5in. diameter outside 1·125in. diameter inside
Mean circumferential stress in tube	585 lb. per sq. in.
Chemical composition of tube ..	C, 0·16 ; Si, 0·007 ; Mn, 0·67 ; S, 0·029 ; P, 0·028
Hours of operation	16,000

There was no reason to suspect general overheating due to restricted steam flow, although it is probable on account of the central position that the steam delivered by the selected tubes was higher in temperature than that delivered by the superheater as a whole. Differences of

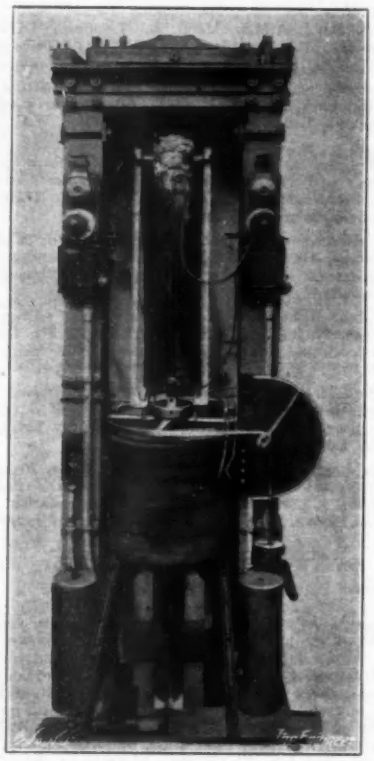


FIG. 1

this kind, however, will occur in all designs of superheater, and it is an important matter that the design should ensure a minimum difference. The case chosen cannot be regarded as one of high initial temperature, as in the latest developments of steam power plant temperatures 100 deg. Cent. higher are provided for, and temperatures 50 deg. Cent. higher have been employed for a number of years. Nevertheless, under the easier thermal conditions of the case dealt with, all the structural changes—spheroidisation of the cementite—that metallurgists would anticipate to occur at such higher temperatures have been encountered, and laboratory tests indicate that they are to be expected under present conditions. Any influence such structural changes have upon physical properties has occurred, therefore, under present operating conditions, and an increase in operating temperature would only hasten the changes, but it is not likely to alter their character. This is encouraging for development to higher initial temperatures, provided working stresses are reduced to allow for the lower resistance offered by the metal to creep, and the circumstances are not such as to result in serious oxidation of the metal.

The question naturally arises whether spheroidisation of the cementite affects the resistance of steel to creep at working temperatures. It would be expected to result in a reduction by an amount depending upon the carbon content of the steel. Globules of cementite will reinforce the ferrite grains against slip and the extent of this reinforcement will depend upon the amount of cementite present, *i.e.*, upon the carbon content of the steel. The author has made several comparative long-duration or creep tests at 450 deg. and 500 deg. Cent. upon 0·9 per cent. C steel—*i.e.*, pearlite composition—with the cementite in both the lamellar and fully spheroidised conditions. These show that for the same creep rate spheroidisation results in this case in a reduction of the stress of approximately 25 per cent. The effect would vanish in the case of a steel of negligible carbon content, *e.g.*, Armco iron, and it would have intermediate influence in the case of the usual medium-carbon steels. Research is needed to establish definitely the influence of spheroidisation of cementite upon the resistance of steels of different carbon content.

As the effect of spheroidisation of cementite is to reduce creep resistance it is desirable to retard the change. It is well known that an annealed steel is more resistant to spheroidisation of the cementite than the same steel in a strained condition. It is suggested, therefore, that for high temperature service superheater tubes and steam pipes should be fully annealed after final drawing or rolling.

Considering the bearing of the foregoing upon the phenomenon of creep, the superheater tube at its outlet section was under a circumferential stress of 0·26 tons per square inch and was subjected for 16,000 hours to a temperature probably not more than 450 deg. Cent. A reference to published data upon creep of this class of steel shows that the working stress is only a fraction of the so-called limiting creep stress. For example, Tapsell and Clenshaw give the limiting creep stress of 0·17 per cent. C steel at 450 deg. Cent. as 9·5 tons per square inch. Nevertheless,

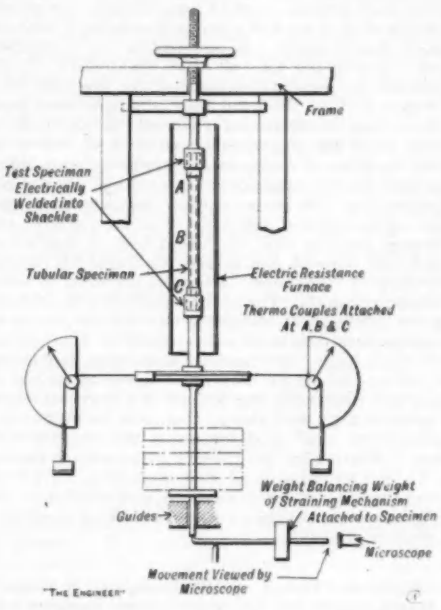


FIG. 2

in the tube examined changes in microstructure show that there has been movement of the cementite, *i.e.*, a rearrangement of the metal, and as this has occurred in the presence of stress it seems likely that changes in dimension or creep have occurred during the whole period of operation. The amount of movement, however, would be far below that capable of detection by the means of measurement at present developed in creep testing. Thus support is given to the view that creep continues at stresses considerably below those at which the smallest rates have been measured. Steels at initial steam temperatures and working stresses must therefore be regarded, not as permanent and elastic material, but as subject to creep, and it is necessary to know the behav our not only under simple stresses, but also under compound stresses which usually occur in practice if the most effective use is to be made of a given material.

The case of a thin cylindrical tube or shell under internal pressure will illustrate by way of example the present need for knowledge. The wall is subjected to a circumferential stress, an axial stress of half the circumferential stress and a radial stress varying from the fluid pressure at the inside to zero at the outside of the tube. A question of some importance in connection with pipes under internal pressure, since it affects the thermal stresses in a steam pipe line, is whether and to what extent axial creep occurs and how it is related to circumferential creep.

CREEP UNDER COMPOUND STRESSES.

As creep must be expected under working conditions in steam power plant, it becomes necessary to know the behaviour of metals, particularly steel, subjected to compound stresses under the plastic conditions signified by the occurrence of creep. In the absence of experimental data the author made an attempt some time ago to anticipate the behaviour of metals under compound stress at elevated temperatures from their known behaviour at atmospheric temperature. The experimental data given below do not support the hypothesis then employed, namely, that creep might be assumed to result from shear only upon the planes of maximum shear stress, but they indicate that creep is more complex than was supposed. The field of inquiry opened up is extensive and will require considerable research of a lengthy character in its full exploration. Some preliminary tests made by the author are described below and deductions of practical interest are given. It is hoped the investigation will indicate a line of procedure and encourage further research.

Two series of tests are recorded ; one was made upon steel tubes strained separately at the same temperature by tension and torsion producing equal maximum shear stress ; and the other was made upon lead pipes under internal pressure with superimposed axial loading.

I.—TESTS UPON STEEL TUBES UNDER TENSION AND TORSION PRODUCING EQUAL MAXIMUM SHEAR STRESSES.

Apparatus.—A view of the apparatus employed is given by Fig. 1. Fig. 2, which is self-explanatory, indicates diagrammatically the features of the apparatus illustrated and its principle of operation. Axial creep of the whole specimen was measured definitely to 0·0001in. and angular creep to 0·02 deg. or 0·00035 radian. Temperature was controlled to within plus or minus 0·3 deg. Cent. of the mean value.

Specimens.—The specimens were made from solid-drawn steel tubing of 0·115 per cent. carbon content specially selected for smoothness and accuracy of bore. Lengths of tube were carefully and accurately straightened, after which they were held at 650 deg. Cent. for a period of one hour and slowly cooled. They were again tested for straightness, and only those pieces were machined that were found to be satisfactory. The machined surface was

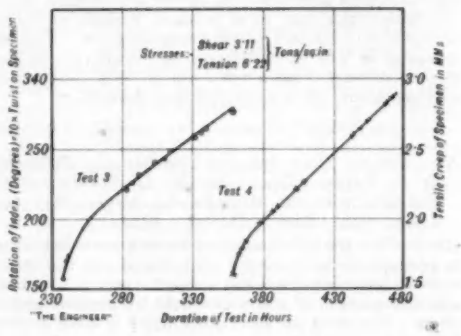


FIG. 4

closely examined under a low-power microscope and magnetic tests were made for the detection of flaws. The form and dimensions of the test pieces are shown by Fig. 3. To avoid the possibility of any slip in the chucks the specimens were electrically welded to the chucks.

Tests.—In order to eliminate variation in material and in its condition, a succession of tests was made upon the same test piece without alteration of temperature and with the minimum interruption in testing when changing the straining action. The procedure was as follows :—A test piece was strained by a constant torque until the angular creep rate was sufficiently definite to be determined, when the torque was replaced by the requisite tensile load, introduced without shock. The tensile load remained until the axial creep became sufficiently definite to be determined, when the load was replaced by the original torque. A succession of alternate torsion and tensile tests of this kind was made, readings of axial creep and angular deformation being taken until sufficient data had been obtained, or the appearance of some irregularity indicated a change in condition. For example, in some early tests splitting of tubes was detected in this way. After the completion of a series of tests the specimens were proved by examination to be sound.

Results.—Two series of tests were made at temperatures of 480 deg. Cent. and 550 deg. Cent., the maximum shear stress at the former temperature being 3·11 tons per square inch and at the latter 1·55 tons per square inch.

Table I. gives the creep rates obtained and Fig. 4, representing tests Nos. 3 and 4, shows a typical deformation-time record. Tests Nos. 1 to 8 inclusive were made in

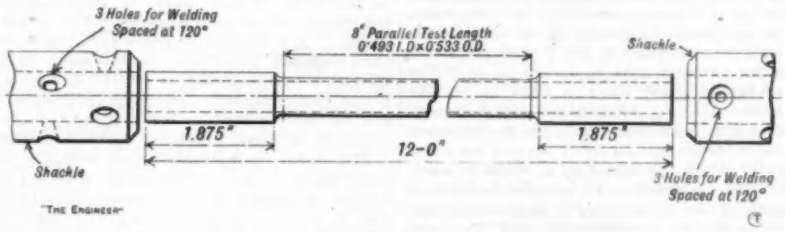


FIG. 3

numerical order upon the same specimen, and Nos. 9 to 14 similarly upon another specimen.

TABLE I.

Test No.	Creep rates for condition : Max. shear stress = 3·11 tons per square inch. Temp. = 480 deg. C.		Test No.	Creep rates for condition : Max. shear stress = 1·55 tons per square inch. Temp. = 550 deg. C.	
	Torsion, radians per inch per hr. i.	Tension, strain per hour. e.		Torsion, radians per inch per hr. i.	Tension, strain per hour. e.
1	204×10^{-6}		9	1190×10^{-6}	
2		$56\cdot2\times10^{-6}$	10		338×10^{-6}
3	175×10^{-6}		11	750×10^{-6}	
4		$46\cdot2\times10^{-6}$	12		261×10^{-6}
5	162×10^{-6}		13	606×10^{-6}	
6		$38\cdot4\times10^{-6}$	14		228×10^{-6}
7	156×10^{-6}				
8		$40\cdot7\times10^{-6}$			

Comparative values of creep rates under the two strain-

* World Power Conference, Sectional Meeting, Tokio, 1929.

ing actions have been determined by taking the mean rate for two successive tests of the same kind to correspond with the rate for the intervening test of the other kind. Thus six corresponding rates are provided by the tests at 480 deg. Cent. and four corresponding rates by the tests at 550 deg. Cent. These rates are given by columns 3 and 4 of Table II. In comparing the results of the two different straining actions, however, it is necessary to evaluate the tensile creep rates for the torsion tests and for this purpose a suitable basis must first be established.

Figs. 5 *a* and *b* show the principal stresses acting at the tube wall in the torsion and tension tests respectively. Stress p has the value 6·22 tons per square inch in tests Nos. 1–8 at 480 deg. Cent. and 3·1 tons per square inch in tests Nos. 9–14 at 550 deg. Cent. The shear stress on all planes perpendicular to A B C D and similarly inclined to A B is the same in the two cases (*a*) and (*b*), but the stress acting normally upon these is different. Also in the case of corresponding planes parallel to A B and inclined to A B C D the shear stress for the case of torsion (*a*) is one-half that occurring under tension (*b*). If creep were

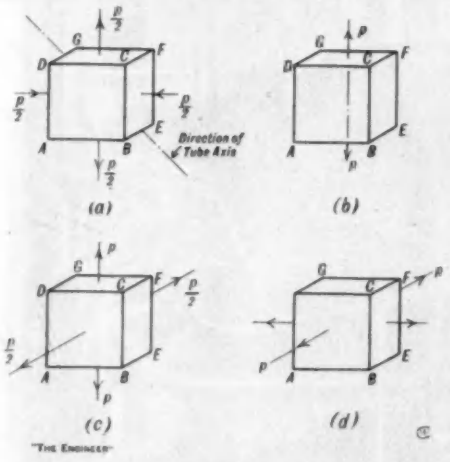


FIG. 5

due only to the maximum shear stress and took place by shear only upon the plane thereof uninfluenced by the stress acting normally to these planes, the tensile creep, *i.e.*, in direction A D, in the two cases (*a*) and (*b*) would be the same. This is not the case in the present tests, and other tests at the same temperature and maximum shear stresses made by the author upon similar tubes under combined axial loading and torque, as also the results of tests upon lead pipes referred to later, show definitely that the creep corresponds with shear upon additional planes to those where the shear stress is a maximum. So far as the author's experiments go they indicate that under the condition of stress and temperature concerned creep by shear may be regarded as general. The results of the author's tests upon steel tubes under combined torsion and axial load will be published in due course.

In the torsion tests observations were made continually to determine change in length, *i.e.*, by axial creep, but none was detected. From the nature of simple shear stress it follows, provided the material is isotropic, that no change in tube diameter would occur. This was confirmed by the total change in tube diameter measured at the end of a series of torsion and tension tests, which was found to correspond in each case with the total axial creep produced

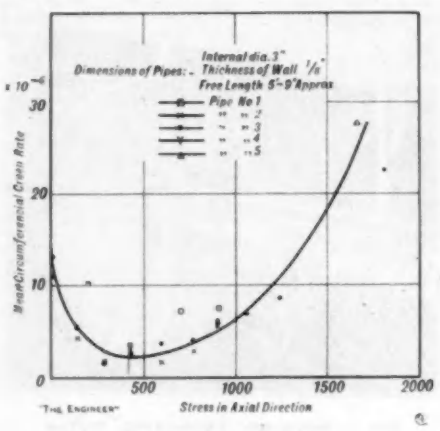


FIG. 6

by the tensile tests assuming constant density of the material. It may be taken that during torsion the change in tube diameter, like that of length, is zero or negligible, and consequently there is zero or negligible change in the tube wall thickness. Important deductions can be made from the constancy of dimensions during torsional creep.

In the first place the creep in the directions of the tensile and compressive principal stresses of Fig. 5 are equal in magnitude. And if each has the magnitude e^1 its value in terms of the angular creep is given by the relation

$$e^1 = \frac{\gamma}{2} i \text{ tensile or compressive,}$$

where e^1 = creep rate in tensile or compressive strain per hour.

i = angular creep in radians per inch length per hour.

γ = mean radius of tube in inches = 0·2565in.

Or, for the tubes tested, neglecting the small change in γ that accompanies creep in the tensile tests,

$$e^1 = 0{\cdot}1282 \, i \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

TABLE II.

Test No.	Temp., deg. C.	Creep rate torsion, radians per inch per hour. i.	Tension strain per hour. e.	Creep rate in direction of principal stresses, $e^1 = 0{\cdot}1282$. i.	$\frac{e}{e^1} = n$.
1–3	480	189×10^{-6}	$56{\cdot}2 \times 10^{-6}$	$24{\cdot}23 \times 10^{-6}$	2·32
2–4	480	175×10^{-6}	$51{\cdot}2 \times 10^{-6}$	$22{\cdot}44 \times 10^{-6}$	2·28
3–5	480	168×10^{-6}	$46{\cdot}2 \times 10^{-6}$	$21{\cdot}54 \times 10^{-6}$	2·145
4–6	480	162×10^{-6}	$42{\cdot}3 \times 10^{-6}$	$20{\cdot}76 \times 10^{-6}$	2·04
5–7	480	159×10^{-6}	$38{\cdot}4 \times 10^{-6}$	$20{\cdot}37 \times 10^{-6}$	1·89
6–8	480	156×10^{-6}	$39{\cdot}5 \times 10^{-6}$	$20{\cdot}0 \times 10^{-6}$	1·97
9–11	550	970×10^{-6}	338×10^{-6}	$124{\cdot}3 \times 10^{-6}$	2·72
10–12	550	750×10^{-6}	299×10^{-6}	$96{\cdot}1 \times 10^{-6}$	3 11
11–13	550	688×10^{-6}	261×10^{-6}	$88{\cdot}2 \times 10^{-6}$	2·96
12–14	550	606×10^{-6}	244×10^{-6}	$77{\cdot}6 \times 10^{-6}$	3·15

Table II. gives values of e^1 calculated by means of equation (1) and also ratios of the axial creep in the tensile tests to the creep in the direction of the principal stresses in the case of torsion, *i.e.*, the ratio of creep rates in the direction A D of the corresponding cases represented by Fig. 5, *a* and *b*. It is noteworthy that whereas the ratio $\frac{e}{e^1}$ has a value in tests Nos. 1–8 made at 480 deg. Cent. of the order of 2, in the tests Nos. 9–14 made at 550 deg. Cent. its value is in the region of 3. Possibly at a higher temperature a still larger ratio would occur, as will be shown later to have been the case with the lead pipes tested. A knowledge of the variation of this ratio with stress and temperature would contribute much to an understanding of the phenomenon of creep.

II.—Experiments upon Lead Pipes under Internal Pressure and Superimposed Axial Load.

Owing to the practical difficulties of making tests at high temperature upon metal tubes under internal pressure and superimposed axial loading, where it is desired to take measurements of axial and diametral creep, it was decided to make some tests upon straight lengths of lead pipes under water pressure. Arrangement was made to apply tensile or compressive axial loads, thereby enabling the axial stress in the tube wall to be varied from zero up to as much as twice the circumferential tensile stress which throughout was maintained constant by the constancy of the water pressure.

As a preliminary all tubes were steamed at 100 deg. Cent. for eight hours to standardise their condition. Thin

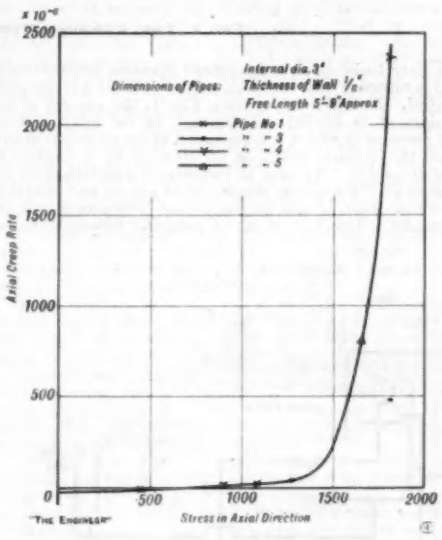


FIG. 7

metal strips were wrapped at intervals around the tube and a strip was arranged longitudinally with one end attached to the tube and the other end free. Circumferential creep was measured by change in the length of the gap between the ends of the circumferential strips or between one end and a graduation upon the other end of a strip. Axial creep was measured similarly by the movement of the tube relative to the end of the strip arranged axially. Measurements were taken over a length sufficiently removed from the ends to be free from end effect. A microscope was employed for making all measurements.

Particulars of Tests.

Dimensions—	
Internal diameter of pipe	3in.
Thickness of wall	0·125in.
Initial length of pipe on which axial creep was measured	69in.
Circumferential stress	900 lb. per square inch for all tests

Readings of change in dimensions under each condition of loading were taken at intervals of time until sufficient data were obtained to enable the creep rates to be calculated. Five pipes were investigated, which are identified numerically in the order in which they were tested. No. 1 gave somewhat erratic results and as manipulation was doubtless improved in dealing with the subsequent pipes tested more weight must be given to the results for pipes Nos. 2 and 3. Pipes Nos. 4 and 5 were tested only at high axial stresses, particularly to determine the behaviour when the axial stress is twice and nearly twice the circumferential stress.

Results.—The results of all the tests, giving the creep rates as strain per minute, are shown plotted in Figs. 6, 7, and 8.

Referring to Fig. 6, it will be seen that the circumferential creep rate is a minimum when the axial stress is about 450 lb. per square inch, *i.e.*, half the circumferential stress, which occurs under the action of the internal pressure alone. Fig. 7 shows values of the axial creep rates covering the whole range of the tests, and Fig. 8 shows axial creep to a larger scale. This figure is intended to bring out particularly the behaviour under axial stresses up to 1200 lb. per square inch, or about 33 per cent. in excess of the circumferential stress. It will be seen that the absence of axial creep under internal pressure loading alone is definitely established.

Thus the tests appear to indicate that a pipe under internal pressure and without superimposed axial loading is in the most favourable circumstances. Its axial creep is zero and its circumferential creep is a minimum. The superposition of an axial stress, as by a bending moment, will cause axial creep of the wall, tensile for a superimposed tensile stress and compressive for a superimposed compressive stress.

Since zero axial creep occurs when the axial tension is one-half the circumferential tension, the circumferential creep should be zero when the axial stress is twice the circumferential stress. An attempt was made to investigate this point. After completing a series of tests upon pipe No. 3 the axial stress was raised to 1800 lb. per square inch. It failed very quickly by a circumferential burst, but showed irregular enlargement in diameter, suggesting circumferential creep. The test was repeated upon the new tube No. 4 and no circumferential creep occurred. There was extensive axial creep and the tube failed by a circumferential fracture. This test was taken to have established the matter.

As was indicated earlier in the paper, the tests given must be regarded as of a preliminary character. Their purpose is to suggest further research and at the same time to afford some guidance to engineers, who have frequently to make decisions before a complete detail knowledge of a phenomenon is available. A certain degree of concordance has

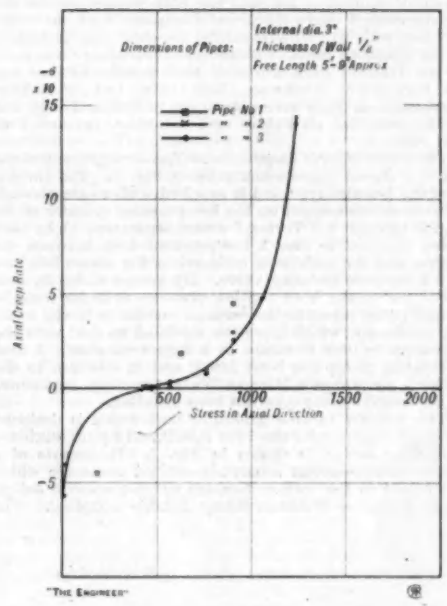


FIG. 8

been found in the deductions made from the tests upon steel tubes at elevated temperatures, and the results obtained in tests upon lead pipes. Until more data are available the ideas embodied in this paper are offered as a more rational view of the behaviour of metals at elevated temperatures than any involving the assumption of an elastic material, even under present common working conditions.

A matter that needs to be remembered when designing parts is that stress concentrations which would occur under elastic conditions are very greatly relieved, or for practical purposes may vanish as a result of creep. Consequently an increase in working stress may be made where stress concentration would ordinarily occur.

B.E.S.A. SPECIFICATIONS.

PHOSPHOR BRONZE BARS AND RODS.

A specification for Phosphor Bronze Bars or Rods has recently been issued by the British Engineering Standards Association. This specification is drawn up on parallel lines with the specifications for brass bars published in 1926, and covers round, square, and rectangular bars from ¼in. to 2in., and hexagon bars for standard nuts from No. 3 B.A. to 1¼in. B.S.W. and 1⅛in. B.S.F., with specified margins of manufacture. The chemical composition of the material, mechanical tests, and the procedure of selecting samples for these tests are laid down. Copies of the specification No. 369, 1929, can be obtained from the British Engineering Standards Association, Publications Department, 28, Victoria-street, London, S.W. 1, price 2s. 2d. post free.

PAINT MATERIALS.

Reference has been made from time to time in these columns to the series of sixty-one British Standard Specifications for Paint, Varnishes and Paint Ingredients, issued by the British Engineering Standards Association, and to the fact that the publication of four further Specifications together with a British Standard Schedule of Colours for Ready Mixed Paints would complete the present programme of such work undertaken by that Association. Of these four remaining publications, one has recently been issued, namely, "B.S.S. for Turpentine Type 2," and announcement is now made of the publication of two more, as follows:—"B.S.S. No. 370–1929. Venetian

Red for Paints." "B.S.S. No. 371–1929. Ready Mixed Linseed Oil Paint (Oil Gloss), Purple Brown Oxide of Iron."

These Specifications follow the lines of those previously issued, and contain clauses regulating the composition, together with standard reception tests for the purchase of these materials; appendices also being incorporated outlining standard methods for carrying out the tests.

Copies may be obtained from the British Engineering Standards Association, Publication Department, 28, Victoria-street, S.W. 1, price 2s. 2d. *each*, post free.

Auxiliary Turbo-Electric Propulsion on the ss. City of Hong Kong.

REFERENCE has already been made in a Journal note of our issue of November 1st to the auxiliary turbo-electric drive recently installed on the Ellerman liner the "City of Hong Kong," a vessel of 9678 gross tons, which is chiefly employed in her owner's Indian service. She was constructed in 1924 by Earle's Shipbuilding and Engineering Company, Ltd., of Hull, and was originally propelled by a quadruple-expansion steam engine with a designed output of 4400 I.H.P. With a view to providing increased propelling power combined with a reduction in the fuel consumption, it was decided by her owners to fit auxiliary turbo-electric propulsion.

The new machinery includes, as Fig. 2 indicates, an exhaust turbine driven generator set, which takes steam from the low-pressure cylinder of the reciprocating engine and supplies direct current to a propelling motor placed upon an after section of the propeller shaft. The particular design of equipment adopted has been worked out by the Metropolitan-Vickers Electrical Company, Ltd., in collaboration with Mr. W. Hinchcliffe, the chief superintendent of the Ellerman Line. The electrical machinery was built at the Trafford Park works of Metropolitan-Vickers and was installed by Workman, Clark (1928), Ltd., at Belfast. Successful sea trials were carried out in Belfast Lough and in the Irish Sea on Friday and Saturday, October 11th and 12th.

The Turbo-electric Installation.—The arrangement of the plant is shown diagrammatically in Fig. 1. The turbine is of the impulse type and is supplied with steam through an exhaust connection on the low-pressure cylinder of the engine through a "Vortex" steam separator. A by-pass valve designed to give a low pressure drop between the engine and the turbine is included in the steam line and also a separate isolating valve. By means of the by-pass valve the steam from the low-pressure cylinder may be passed either direct to the exhaust turbine or to the existing condenser, which has been modified to deal with the increased volume of steam at a higher vacuum. A new circulating pump has been fitted, and in addition to the existing air pumps a Mirrlees-Watson vacuum augmenter of the steam ejector type has been installed.

The exhaust turbine generator unit which is designed to supply current for the 1300 S.H.P., 83 r.p.m. auxiliary propelling motor, is shown in Fig. 2. It consists of a steam turbine-driven separately-excited generator which is coupled to the turbine through single-reduction helical gearing and a Wellman-Bibby flexible coupling. The

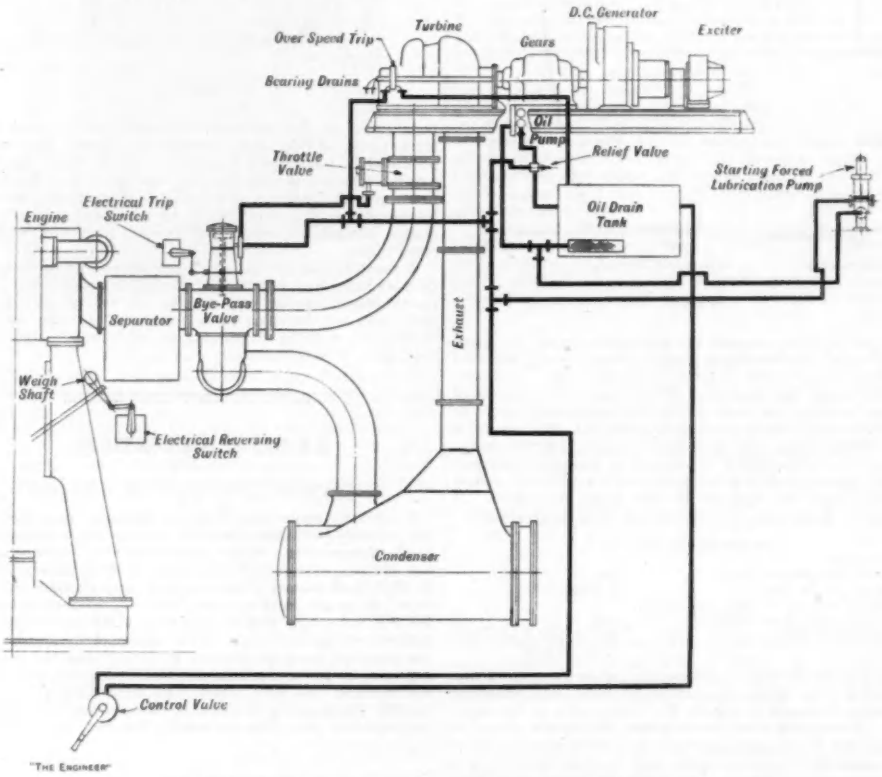


FIG. 1—DIAGRAM OF PLANT AND OIL RELAY CONTROLS

motor, which is shown in Fig. 3, is built into the line of the propeller shafting and is fitted well aft. The motor is of the multipolar type with closed circuit water-cooled ventilation. The commutator is not included in the ventilating circuit and is therefore left free for inspection without dismantling any parts. There is a temperature alarm, which, in the event of any inadmissible rise in temperature in the windings of the motor, gives a warning signal in the engine-room. The armature is very robustly constructed and the bearings are of the disc-lubricated type, which are suitable for marine conditions.

In Fig. 4 we show the control cubicle, which is placed alongside the starting platform of the main engine, part of the starting hand wheel for the steam engine being seen to the right hand. The auxiliary propelling machinery is started or stopped by the single central handle on the panel, while to the right and left are the regulator hand wheels, which adapt the running of the plant to required conditions. The other instruments and gauges on the cubicle panel are for indicating the operating conditions.

The Methods of Control.—When once in commission the auxiliary turbo-electric equipment operates automatically and is reversed with the main engine without any separate control. As will be seen from Fig. 1, the control of the equipment is carried out through an oil relay system, the pressure in which is maintained by an oil pump driven from the turbine shaft, or at starting by a separately driven pump. As long as pressure is maintained in the system all the requisite steam valves are set and electrical switches closed so that the equipment continues to operate normally. Any failure in oil pressure, however, immediately causes the relay-operated steam valves to close and isolate the steam turbine from the main engine so as to allow the exhaust steam to pass directly to the condenser. By the same operation the electrical machinery is also switched out of commission. To put in or throw out the auxiliary electrical drive only a single movement of a hand-operated control valve in the oil relay system is required. There are also emergency trips, which operate by releasing the oil pressure in the same system. There is a turbine-driven lubricating oil pump on the same shaft as the pump for the oil relay system, and, as previously mentioned, a separately-driven starting up pump for building up the pressure in the relay system and for flooding the turbine bearings. As soon as the set has been run up to speed this pump is shut down.

Some Trial Results.—On October 11th and 12th, in Belfast Lough and the Irish Sea, consumption trials were run with the auxiliary propelling machinery both in and out of commission, and these tests were followed by a twelve hours' endurance trial with reversing tests. In addition, some special runs were made in order to demonstrate the independence of the turbine and engine operating speeds. A summary of the trial results is given in the table on page 531. A trial of one hour and forty minutes' duration was first run with the main engine and the auxiliary electrical propelling system, both in operation and developing about 4900 total equivalent I.H.P. During the trial period indicator cards were taken from the engine at intervals of a quarter of an hour and other steam and electrical readings were taken at five-minute intervals. Special arrangements were made to measure accurately the vacua at different parts of the plant and also the condensate, feed water, and the oil temperature. The quantity of condensate was also measured, and the power of the auxiliary propelling motor was calculated from the observed ammeter and the voltmeter readings and from the efficiency curve of the machine as determined in the makers' works. In converting the motor S.H.P. into equivalent I.H.P. the mechanical efficiency of the engine was taken to be 89 per cent. These measurements were

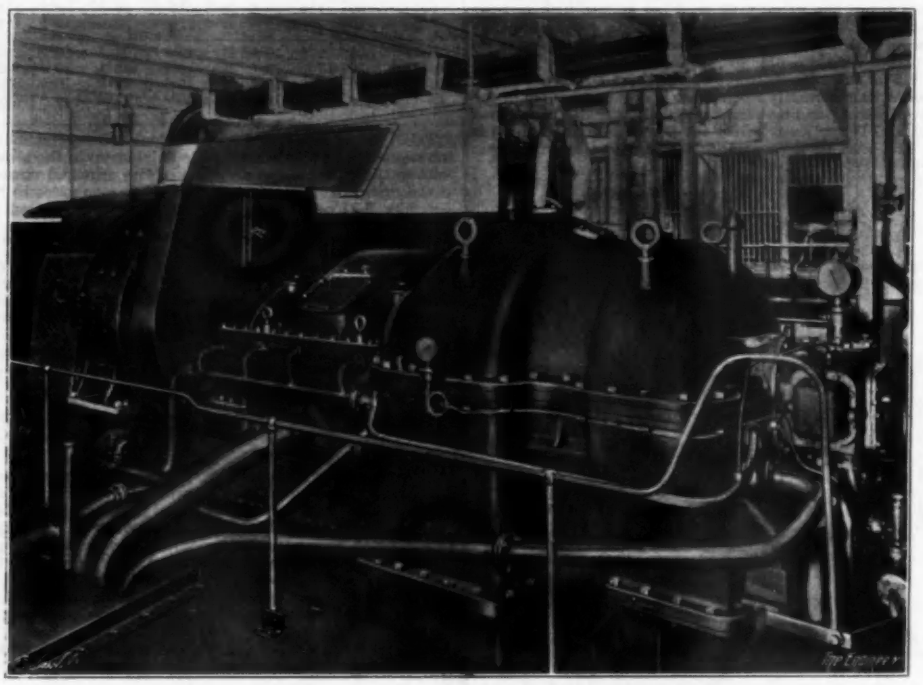


FIG. 2—THE EXHAUST-TURBINE-DRIVEN GENERATOR SET

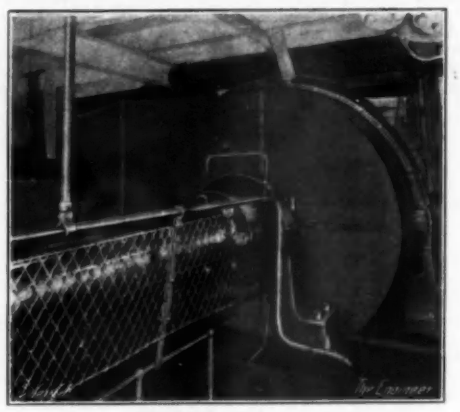


FIG. 3—AUXILIARY PROPELLING MOTOR

repeated in another trial of one hour's duration, during which only the reciprocating engine was working. From the results of the trials given in the accompanying table it may be noted that the steam consumption per equivalent I.H.P.-hour was 23 per cent. less with the exhaust turbo-electric system in operation than with the reciprocating engine alone. It will be noted that a correction has been made for the effect of the lower vacuum at the exhaust outlet, which is caused by the interposition of the steam separator and the by-pass valve between the engine and the condenser. Trials made under various conditions of vacuum before the electric system was installed enable the corrections to be made.

The plant operated very satisfactorily during the twelve hours' full-speed endurance trial, and at the end of this trial the speed of the ship was reduced to 75 per cent. of the normal. Under full-power conditions the proportion of the total power developed by the auxiliary propelling motor was 27½ per cent., which figure fell to about 20 per cent. when the ship was run at three-quarter speed. A number of reversals were made with the vessel steaming at about 80 per cent. of her normal speed. The auxiliary propelling machinery was reversed with the engine and

full power astern was attained in approximately ten seconds from the shutting off of the steam with the engine running in the ahead direction.

In order to test the steadying effect of the auxiliary equipment, the ship was taken to sea in heavy weather off the Irish coast on the night of October 10th. She was steaming at light draught with the propeller partly out of the water. The load on the electrical machinery which formed the coupling between the engine and the exhaust turbine varied from 20 to 100 per cent. of the full load. The full propeller revolutions were maintained and the fluctuation of the propeller speed was barely noticeable. In a later trial the equipment was tried out under reduced propeller speeds. At a chosen propeller speed of 60 r.p.m. the natural turbine speed was 2080 r.p.m. and the power developed by the motor 345 B.H.P. By altering the speed ratio of the electrical coupling, the turbine speed was then increased to 2850 r.p.m., under which conditions the motor output rose to 368 S.H.P., the speed of the engine being maintained at 60 r.p.m., with consequently the same consumption of fuel. The increase in output was due to the better performance of the exhaust turbine at the higher speed, and was shown to be equivalent to a 2 per cent. increase in the total power available with a coupling having a fixed speed ratio. Incidentally, the fly-wheel effect of

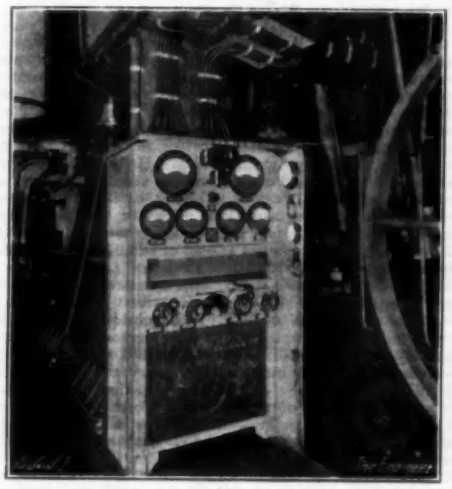


FIG. 4—CONTROL CUBICLE

the turbine which was available for propeller speed steadying was increased 87 per cent. by the change in the turbine speed.

In a similar installation which is to be fitted in another Ellerman Line vessel a direct steam connection to the exhaust turbine is to be provided. With this provision it will be possible to maintain a speed of from 6 to 7 knots with the turbine only in operation in the admittedly unlikely but possible total breakdown of the reciprocating engine.

Summary of Trial Data.

Exhaust turbo-electric installation.	In.		Out.
Steam pressure at boiler, lb. per sq. in. g.	221·6	..	220·0
Steam pressure at H.P. receiver, lb. per sq. in. g.	212·9	..	211·7
Steam pressure at engine exhaust, lb. per sq. in. abs.	7·15	..	3·7
Steam pressure at turbine inlet, lb. per sq. in. abs.	7·19	..	—
Vacuum at turbine exhaust, hg. (bar. 30in.)	28·591	..	—
Vacuum at condenser inlet, hg. (bar. 30in.)	28·715	..	27·0
Steam temperature at H.P. receiver, deg. Fah.	566·4	..	558·3
Condensate temperature at condenser outlet, deg. Fah.	83·9	..	—
Condensate temperature at air pump discharge, deg. Fah.	98·8	..	94
Feed temperature to boilers, deg. Fah.	210·5	..	193·5
Sea temperature, deg. Fah.	54·5	..	54·5
Circulating water discharge temperature, deg. Fah.	76·9	..	85
Steam pressure at augmenter, lb. per sq. in. g.	150·1		Not in use
Circulating water pump speed, r.p.m.	291	..	285·5
Relay oil pressure, lb. per sq. in. g.	83·2	..	—
Bearing oil pressure, lb. per sq. in. g.	15·7	..	—
Oil temperature entering cooler, deg. Fah.	115	..	—
Oil temperature leaving cooler, deg. Fah.	100·5	..	—
Propeller speed, r.p.m.	84·5	..	75·2
Power developed by reciprocating engine, I.H.P.	3,385	..	3,190
Motor volts	420	..	—
Motor amps.	2,550	..	—
Motor output, S.H.P.	1,330	..	—
Motor output, equivalent I.H.P.	1,495	..	—
Total power developed, equivalent I.H.P.	4,880	..	3,190
Condensate, lb. per hour	44,300	..	38,650
Actual steam consumption of engines, lb. per I.H.P.-hour	9·085	..	12·12
Correction to engine steam consumption for high back pressure of 3·70 lb. per sq. in. abs. instead of 25·0in. hg. vac. at engine exhaust due to separator now placed between engine and condenser (from tests before conversion), per cent.		2·5	
Corrected steam consumption of engines, lb. per I.H.P.-hour	9·085	..	11·82
Decrease in steam consumption due to exhaust turbo-electric system, per cent.		23·0	

Progress of the Fushun Coal Mine, Manchuria.

THE following account of the present state of activities at the great open-cut coal mine of Fushun, Manchuria, is taken from the *Far Eastern Review*.

"Coal mines as a rule are anything but attractive, and colliery towns are usually scars on the landscape. In Fushun, however, is the largest open-cut coal mine in the world. An enormous gash has been made in the face of the earth some 3 kiloms. in length, and the even terraces which are left along the sides after the coal has been won by the stripping method present an extraordinary and, when the amber deposits streaking the coal vein catch the sun's rays, a beautiful sight. Not only is the open-cut coal mine here the largest of its kind in the world, but the coal is probably the cheapest. The Japanese engineer in charge admits that the cost of mining is far below that of the Kailan Mining Company's mines near the Great Wall, which is 1·80 dollars Mex. a ton.

"Here, too, is perhaps the best example in Manchuria of the capacity of the Japanese to make bold decisions. Not many years ago a city of about 40,000 inhabitants was built here when the South Manchuria Railway Company took over the Fushun coalfields and started to develop them on a large scale. Rail lines, business houses, paved streets, schools, hospitals and amusement houses were built.

"After all these things had been completed it was discovered that the largest coal vein in the field ran directly under the city. The coal was almost on the surface and could be mined from an open cut, so the entire city was, or rather is still, being moved to a new site three miles away. Already the New Town, as it is called, has taken shape and promises to be the finest city in Manchuria. Three enormous hospitals, schools, offices, business houses, a new railway station and beautiful residences for the officials and miners have been erected. There are still many buildings left in the Old Town, but the mine executives estimate that in ten years there will be no trace of the Old Town left. To-day a four-storey brick hotel stands on the edge of the immense pit and to-morrow it is gone. In two months' time the entire block in which it stood will be gone and forgotten.

"The Fushun coal deposits were discovered some seven centuries ago, and during the Yuan Dynasty they were worked by the Koreans. When the Manchus came into power, however, out of superstitious regard for the spirits of their departed imperial ancestors who were buried near here, the work was stopped. During the time the Russians controlled Manchuria the mines were worked by them, but the output was only about 360 tons daily. Last year the average output under the Japanese was 30,000 tons daily. The deposits are quite compact, the total length being about 10 miles and the width a mile and a-half. The seams reach a maximum depth of 3000ft. As the vein runs westward it becomes thicker, and at the extremity is 400ft. At present three shaft mines, five inclined shafts, one large open pit and two smaller ones are being worked. Excavations and borings have been made, and it is estimated that the entire deposit contains well over a billion tons. [? one thousand million tons.—ED. THE E.]

"The principal consumers of the coal are the South Manchuria Railway, the Anahan Ironworks, electricity and gas plants in South Manchuria and Japan, and the average sale price is 5 yen a ton f.o.b. Fushun.

"The enormous open pit was started only seven years ago and is now 200ft. deep. The vein runs down 1000ft. here, and it is estimated that in twenty-five years this depth will be reached. Steam and electric shovels are used for the stripping. Dynamite charges are used to blast the coal loose along the terraces, and the shovels are used to pick it up and dump it into the cars which run along each terrace. Two shifts of ten hours each, with an interval of two hours between shifts, are worked.

"Perhaps even more interesting than the coal mines here is the oil shale industry. Here the vital question of supplying oil for Japan's Navy is being solved. A great new plant for the distillation of oil from the shale deposits here is nearing completion. The system which is to be used is something new in oil distillation. After studying systems used in the United States and England in distilling oil shale, the Japanese engineers in the Fushun coal mines here have perfected a new and, they proudly claim, better system. The new plant, when completed, will cost Y. 7,000,000 and have a capacity for treating 12,000 tons of oil shale daily.

"The shale deposits lie above the coal seams and the actual tonnage runs into an enormous figure. Many estimates have been made and figures quoted, the most conservative of which is 3,500,000,000 tons. The quality of the shale varies, being very rich at the top and gradually getting poorer as the strata deepen. The average oil yield is about 6 per cent., the range being from 14 to as low as 1 per cent. If the poorest strata are discarded the average would come to about 8 per cent., which makes the distillation highly profitable.

"If only the top layers of the strata are used, as they must be at first, and assuming the oil percentage at 10, this represents 1200 tons of crude oil daily. Even with the oil percentage at 8, 1 ton of shale will produce 1½ gallons of gasoline, 4·22 gallons of kerosene, 5·58 gallons of gas and fuel oil, 1·54 gallons of lubricating oil, 20 lb. of tar and 40 lb. of sulphate of ammonia. So favourable are the conditions, low cost of labour, fuel and excavation, and the abundant deposits, that oil shale can be worked at a very large profit. The shale within the area of the great open cut alone will supply two and a-half times the amount of crude oil produced from all the oil wells in Japan for thirty years, and the entire deposits more than the Japanese wells for 500 years.

"A very remarkable thing about the coal deposits is the enormous amount of amber in the coal strata. As much as 3 tons of large blocks are picked up daily, and several hundred pounds of smaller pieces are not even gathered. Most of it, however, has particles of coal in it which cannot be entirely eradicated and thus renders its market value very low. It is believed that a huge forest of sequoia trees was the foundation of the coalfield. Many pieces of amber have been found in which perfectly fossilised leaves are embedded. If some method of separating the impurities from the amber can be found amber varnish can be manufactured on a large scale. The Central Laboratory of the South Manchuria Railway in Dairen has worked on the problem for several years, but without success.

"The total number of employees working in the mines is 60,000. Of these, 3000 are Japanese and the remainder Chinese. The city and colliery district combined has a population of about 90,000, of whom some 70,000 are Chinese, 15,000 Japanese and the rest Koreans and Russians. The medical, educational and social features of this thriving little city are interesting. The hospitals are strikingly handsome buildings and their equipment and staffs are capable of handling any case. A mutual relief association has been formed by the mining company, to which each man donates one day's pay monthly, the company matching the total subscriptions. Co-operative stores have been established where the miners can buy goods at cost. Libraries, clubs, employees' associations and athletic clubs have been formed and are well patronised. Each labourer is supplied with free quarters, fuel, electric light, water, bath and a hair-cut. His only outlay is for food and clothes. Food is supplied under the management of the company, and the average cost is 11 sen a day for each person. The average daily pay of the miners is 70 sen."

LIÉGE AND THE CENTENARY OF THE INDEPENDENCE OF BELGIUM.

WITH a view to celebrating the Centenary of the Independence of Belgium two exhibitions are to be held in that country in 1930. Both are to be of an international character:—One, which is to be at Antwerp, will be devoted to the colonial and maritime activities of the nations of the world—particularly the developments of the Belgian Congo; while the other—at Liége—will be of wider scope and is intended to emphasise the benefits which civilised races derive from the co-operation of science and industry.

A brochure dealing specially with the Liége Exhibition lies before us, and from it we have extracted the following information:—The Exhibition, which is to be under the patronage of the King and Queen of the Belgians and is to be held under the Presidency of the Duke and Duchess of Brabant, has received the moral and financial support of the Belgian Government. It is to be opened in May and it will last for six months. It will cover an area of 150 acres and the floor space of its pavilions will extend to 200,000 sq. yards. The following countries have already accepted the invitation of the Belgian Government to take part in it:—Brazil, Chili, China, Colombia, Costa-Rica, Czechoslovakia, Egypt, Ecuador, France, Greece, Holland, Hungary, Italy, Japan, Luxemburg, Morocco, Peru, Poland, Spain, Sweden, Uruguay and Yugoslavia. The official adhesion of many other nations is said to be impending, while many large American, British, French and German business undertakings have signified their intention of participating. France, apparently, is to be particularly well represented, the area allotted to it being in excess of 28,000 sq. metres. Italy is erecting a building which will cover 7500 sq. metres. Brazil, Czechoslovakia, Egypt, Holland, Japan, Luxemburg, Poland and Spain are also considering the question of building their own national pavilions. The Liége provincial authorities are erecting an inter-provincial pavilion in which nine Belgian provinces will place their exhibits, while the Ministry of Industry, Labour and Social Questions is proposing to construct a building in connection with the interests of its different Departments. The City of Liége is to concentrate its exhibits in a permanent palace which is now being built.

A large number of international Congresses is to be held in Liége during the continuance of the Exhibition. Among the subjects of these Congresses are Applied Physics; Radiotelegraphy; Industrial Chemistry; Steel Construction; General Engineering; Mines, Metallurgy and Applied Geology; Architecture, &c.

The Secretary-General of the Government Commissariat-General for the Exhibition, is Monsieur Léon Michel, E.M., E.E., and the Exhibition Offices are at 4, Place Saint-Lambert, Liége, Belgium.

LOW-TEMPERATURE CARBONISATION OF COAL.—A paper on "Low-temperature Carbonisation" was read and discussed at a meeting of the Manchester Association of Engineers, held on November 8th. The author was Mr. Harald Nielsen. A feature of the paper was the large number of admirable lantern slides illustrating the geological, chemical and manufacturing phases of the subject. Mr. Nielsen, who is a recognised expert on the subject of low-temperature carbonisation, indicated some recent lines of development, but said there was still a terrific amount of work to be done. He trusted that eventually an independent scientific council would be constituted which would be entirely impartial and consist of a body of men acting as a scientific high court from which anyone with problems to solve could ask advice and where all available information could be tabulated, indexed, sifted and criticised. This council should only act in an advisory capacity and never be permitted to interfere actively, as such interference would be in competition with industry.

EMPIRE COMMERCIAL POLICY.—In view of the forthcoming Imperial Conference in 1930, an arrangement has been come to between the Association of British Chambers of Commerce, the Federation of British Industries and the Chamber of Shipping of the United Kingdom, representing the commercial, industrial and shipping interests of this country, to form a British Preparatory Committee to consider the general question of Empire commercial policy, with the object of co-ordinating as far as possible the views of the business community of the United Kingdom and of presenting to his Majesty's Government joint recommendations on all questions upon which unanimity of opinion can be obtained. Each of the organisations represented has appointed its own Preparatory Committee, the preliminary conclusions of which will be communicated to the British Preparatory Committee for joint consideration. The members of the Committee so far nominated include the following:—Representatives of the Association of British Chambers of Commerce: Sir Gilbert Vyle, ex-President; Sir Edward Iliffe, Vice-President; Sir Francis Joseph, President of the North Staffordshire Chamber of Commerce; and Mr. R. B. Dunwoody, Secretary. The Federation of British Industries: Sir Arthur Duckham, G.B.E., Chairman, F.B.I. Preparatory Committee; Sir Roland Nugent, Director; Mr. Guy Locock, C.M.G., Deputy Director; and Mr. Moir Mackenzie, Empire Department. The Chamber of Shipping of the United Kingdom: Sir William Currie, President; Sir Alan Anderson, K.B.E., ex-President.

Gilled Tubes.

In a paper entitled "Heat Transmission Problems and Some Recent Developments, with Experimental Data," read before the Institution of Engineers and Shipbuilders in Scotland on November 5th, Mr. George Tansley and Mr. Otto Kubalek give an interesting account of experiments with gilled tubes for economisers.

A number of gilled tubes with gills approximately 2in. deep—as in section B, Fig. 1—were tested, the amount of heat transmitted being shown by the corresponding curve B—Fig. 2. These tubes were then put in the lathe, and the gills turned down to a depth of 1in.—as shown in C,

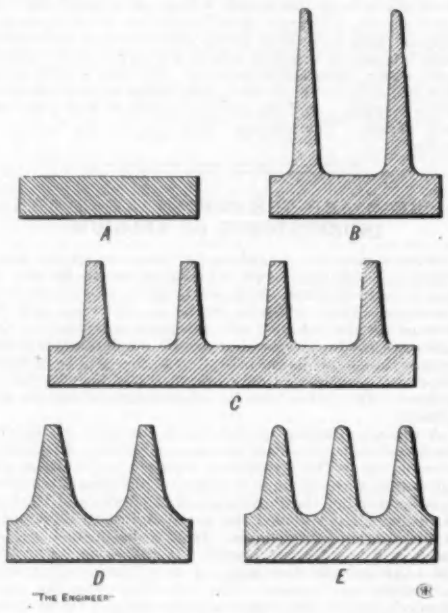


FIG. 1

Fig. 1—and a similar series of tests carried out, the results of which are shown by curve C. The difference in the heat-transmitting value of the shallow gill as compared with the deep gill was so pronounced that it was decided to continue the investigation.

It was, of course, quite obvious that the cross-sectional area of the gill, as compared with its depth was a determining factor, and from other sources it had been deduced that the root of the gill should merge more into the body of the tube, and, therefore, a number of tubes were cast with gills still 1in. in depth, but rather thicker at the root—as shown by D, Fig. 1. Curve D shows the results obtained, and it is quite allowable to assume that the more the gill merges into the tube, the nearer will be the heat trans-

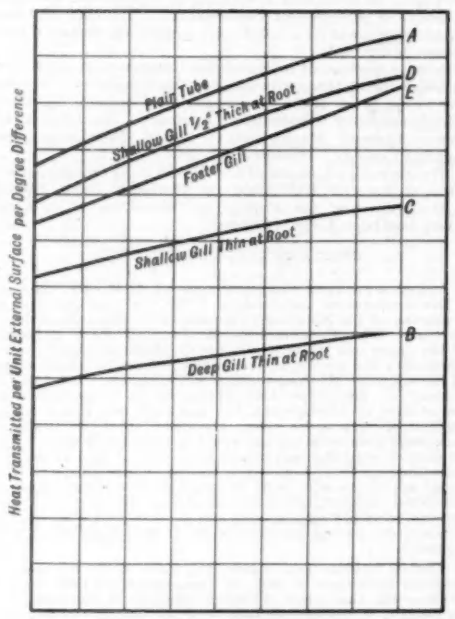


FIG. 2

mission coefficient to that of the plain tube. It is to be noted that the curves in Fig. 2 do not give the actual amount of heat transmitted, but only show the relation between one form of surface and another.

In the first place, it must be remembered that the experiments were conducted with clean air, whereas economisers working under normal conditions would be installed in waste flue gases. It has not yet been definitely determined what percentages should be deducted from the clean air coefficients in order to give a reliable estimate of results under different working conditions. With high-temperature flue gases, high-temperature feed water, and a fairly high gas velocity, working results would closely approach the results with clean air.

On the other hand, if an economiser were working in low-temperature rather dirty flue gases, with low-temperature feed water, it might be necessary to deduct from 15 to 20 per cent. from the clean air heat transmission values. Secondly, the hot air temperatures were measured by means of thermometer bulbs actually inserted in the economiser chamber itself, with the result that these temperature readings were affected by radiation from the actual economiser on the one hand and the casing on the other, the bulbs being exposed. This may have introduced slight inaccuracies, but as radiation losses and radiant effect on the thermometer bulbs would be almost the same for all tests, it was felt that the results obtained were quite sufficiently accurate for commercial comparison, although from the physicist's point of view greater accuracy might have been desirable.

The general conclusions arrived at are as follows:—

(1) The number of B.Th.U's. transmitted per degree difference was, as expected, highest with the plain tube and lowest with the deep gill.

(2) As was also expected, the outer periphery of the deep gill was very much less effective than the inner periphery.

(3) A reduction of 50 per cent. in heating surface by turning off the outer periphery of the gill, resulted in a loss per tube of only 10 per cent. of duty.

(4) To obtain maximum efficiency, there should be a definite minimum thickness of gill at the root relative to its depth.

(5) The relativity of thickness to depth is a variable, depending upon the maximum velocity of the gases passing across the tubes, a deeper gill being more suitable in slow-moving than in high-velocity gases.

(6) The results from a properly designed gill cast on a tube will be approximately equal to the results from a plain tube per square foot of heating surface. Therefore, if the heating surface be increased by means of external gills to n times the heating surface of the plain tube, the number of plain tubes required to perform a given duty will be n times the number of gilled tubes.

As a result of these experiments it was decided to adopt a section of tube similar to D, Fig. 1, and it is a curious fact that the contour of these gills resembles very closely the contour of the extended surface of the Foster economiser, in connection with which all heat experiments were originally conducted in the United States. It is not claimed that this gill is of theoretically perfect contour, but from the point of view of cleaning, reliability, and commercial utility, it is considered to be superior to a gill of greater depth.

South African Engineering Notes.

Magnitude of Copper Deposits.

The mining engineering experts engaged on some of the big copper mining undertakings in Northern Rhodesia have been preparing estimates of the tonnages, and tabulated statements of the size and grade of the ore bodies from N'Dola to N'Changa. The figures form an eloquent testimony as to the importance of Northern Rhodesia as a copper region, and show that the official estimates of the ore reserves of six mines, the Roan Antelope, Bwana M'Kubwa, N'Kana, N'Changa, Mufulera and Chambishi, amount to a total of 51,000,000 tons of sulphide ore, with an average assay value of 3·73 per cent. of copper, and 26,000,000 tons of mixed oxide and sulphide, valued at 3·45 per cent. The general opinion as to tonnages in process of development amounts to a total of 102,000 000 tons of sulphide ore, valued at 4·1 per cent., and of 103,000 000 tons of mixed ore, valued at 4 per cent. The possible future totals for the same six mines are roughly estimated at 360,000,000 tons of sulphide ores, with an average value of 4·1 per cent. copper, and 162,000 000 tons of mixed oxide and sulphide ores valued at 4 per cent. Taking the price of refined copper at only £60 per ton, the value represented by the 20,900 000 tons of copper in the ores would amount to over £1,250,000,000. It must be added that, since the estimates of tonnage were worked out, further developments in entirely new areas have added substantially to the enormous figures given above.

More Power for Pretoria.

The 7500 Belliss-G.E.C. set, which was ordered for thePretoria Municipality awhile back, has now arrived on the site, and it is hoped that the plant will be running before the new year. The capacity of the power station will, even with that addition, soon be inadequate to meet the growing requirements of the town. The new railway workshops will call for a large amount of electricity, and there are at least two factories being built at present which are to be run from the municipal mains. The time when a start in earnest will be made upon the erection of the Iron and Steel Works, which the Government is bringing into existence, is also drawing near now that the plans are being prepared, and the demands for that big undertaking will certainly require the Pretoria Municipality to embark upon a big scheme of extension just as it have had to do with regard to water supply. The Municipality only quite lately began to supply electricity in bulk to Waterkloof township, and now it has arranged to do the same for Innesdale, while very shortly a supply of current will be given to the township of Pretoria North and Silverton.

Manganese Industry.

The British–Swiss International Corporation has paid the Government of the Union of South Africa the sum of £302,000, the estimated cost of the railway now in course of construction between Koopmansfontein and Postmasburg, to enable the manganese from the deposits at the latter place to be railed to Durban for shipment to Europe. In the same connection the Manganese Corporation (1929) has deposited with the Government the sum of £100,000 as guarantee for traffic, &c. The Manganese Corporation was formed by the British–Swiss Corporation some months back for the purpose of developing the manganese deposits, and the railway is being built to serve the Corporation's mines. Messrs. W. H. Mueller and Co., of Rotterdam, have been appointed sole distributors of the manganese ore from the mines. They state that the Postmasburg ore is purer than the ore from any other parts of the world, and that it is not necessary to wash it before it is sent to the blast-furnace, which means reduced costs. The prospectus also states that the price of the South African ore will be kept below that asked for Russian manganese ore. The company reports that all its first shipments of ore, which may be expected early next year have already been sold.

The South African Manganese Company, which owns deposits at Postmasburg, will also have the use of the new line, and is paying the Government about £210,000 as the company's moiety of the cost of constructing the line, and the security required against possible shortfall in revenue. Upon this sum the Government will pay 4½ per cent. interest. The Government has undertaken to redeem the railway capital and deposit within ten years. No difficulty is expected in disposing of the product. The ore is close grained, its storage being 82 cubic feet to 1 ton. It is assumed that the company will be able to transport to the coast at the rate of 250 000 tons per annum at the outset, and on the basis of 10s. per ton profit, which is regarded as extremely conservative, there will be a return of 50 per cent. on the ordinary capital of £250,000.

Port Elizabeth Water Supply.

The great industrial expansion taking place in East London has led to a very rapid increase in the water consumption, so much so that had not the recent drought broken when it did, about the middle of September, the position would have become serious. The city engineer has submitted to the Municipal Board of Works a very comprehensive and critical report of the present position as regards water supply in the city. He details the work carried out since 1919 at the various storage and service reservoirs at a total cost of £215,500, and the additional work now in progress as follows:—A new pumping plant at Van Staden's Gorge with service reservoir, and new 12in. main being completed at cost of £28,000; Sand River Dam being raised by 25ft. at a cost of £63,000; a new 18in. main from Sand River, approximately 10 miles in length, replacing the existing one, which is in bad condition, at a cost of £100,000. It is pointed out that the completed and present work will increase the storage capacity from 336 million gallons to 860,000,000 gallons, not considering the inflow, which may vary from ½ to 1½ million gallons per day in dry periods. The present daily consumption of water ranges from 2½ million to 3½ million gallons per day, and in view of the continued rapid industrial expansion of the city, the engineer points out that at no far distant date this consumption will, in all probability, be considerably increased. The report then details certain proposals to cope with the situation as it exists to-day, and to provide adequate facilities for the future needs. The engineer points out that no engineering scheme, whether it be water supply or otherwise, can be efficiently prepared and carried out if the matter is rushed, and therefore recommends the Council to look well ahead and arrange for the necessary detailed investigations to be effected, which will permit, when the necessity arises, of a scheme which has already been well considered and prepared, to be proceeded with.

The engineer states that with a view to overcoming the difficulty at present experienced in maintaining an adequate supply at sufficient pressure in certain parts of the town, owing to continued extension of mains originally laid down to supply much smaller areas than they are now called upon to serve, it is proposed to re-design the reticulated system, to duplicate certain mains, and in order to stabilise the pressure it is proposed to divide the town into zones with separate reticulation systems for each zone. The engineer further recommends the adoption of the scheme of filtration already submitted and approved in principle, which would include rapid gravity filters, chemical proportioning gear, chlorination plant, and sedimentation tanks, the existing filtration plant being retained as "roughing" filters.

Rhodesian Mineral Production.

The mineral production of Southern Rhodesia for the month of July amounted in value to £404,830, compared with £407,834 for the previous month. The total was made up as follows:—Gold, £196,017; silver, ££04; coal raised, 100,295 tons; sales, £40,813; coal used for coke and bricks valued at £4770; chrome ore, 33,309 tons, £80,604; asbestos, 3585 tons, £78,188; arsenic, 14½ tons, £258; corundum, 1 ton, £12; tin, 4·59 tons, £502; mica, 32,076 lb., £2562; diamonds, 63 carats, £300. There was a reduction in the value of gold produced, as compared with July, 1928, of £10,360. The quantity of chrome ore mined continues to increase, the tonnage for July being 33,309, compared with 15,360 tons for July, 1928. The total quantity of chrome ore mined during the first seven months of this year is 164,211 tons, compared with 137,003 tons for the corresponding period of 1928. Owing to the railway strike no chrome ore was exported in February, whereas 22,424 tons were exported in July, 1928. The value of the total production of minerals in Southern Rhodesia up to date is £93,594,078.

The value of the mineral production of Northern Rhodesia for July was £99,863. Of this gold was responsible for £119; copper (finished), £48,128; lead, £1824; mica, £768; zinc, £48,571; manganese ore, £289; iron ore, £168. The value of the total mineral production of Northern Rhodesia to date is £5,633,812.

Some exceptionally large cylindrical vessels are being made for the Anglo-Persian Oil Company by the English Steel Corporation, Sheffield, and by John Brown and Co., Sheffield. They will be about 45ft. long and 5ft. in diameter, with walls of solid steel 4in. thick. The weight of the ingot required for making each one of the chambers is nearly 160 tons. The completed forging will weigh 86 tons, and after machining the finished article will be about 50 tons. The surfaces are machined all over, and a great part of their bulk removed in the lathe. When finished, the chambers will be tested to a pressure of 3000 lb. per square inch.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Prevailing Market Conditions.

THERE has been very little business passing in any of the various branches of the iron and steel market in the Midlands and Staffordshire this week. The new orders being received at the mills are nothing like sufficient to balance the business being completed, and anxiety as to the future is spreading. Especially is this the case with steel makers, who are faced just now with severe competition from the Continent. The slightly higher range of prices quoted this week for foreign material has had no marked effect upon business. Manufacturers in this area are distrustful of the situation, despite the curtailments of production abroad. The maintaining of recent values in the iron and steel trades at home is a steadying factor, but unless there is a considerable improvement in consumptive demand during the next week or so little re-invigoration of the iron and steel industries here is likely to take place this year. Fortunately, most of the producers of iron and steel have sufficient work to keep them employed for some weeks yet, and given only a small volume of new business they should be able to carry on to the end of the quarter. By that time, however, order books will have been very seriously depleted. The basic trades in this area vary only slightly from the position of the last few months. Some branches of the engineering industry show a slight improvement, in part due to seasonal activity. Electrical engineers are active and automobile engineers are making progress with the new season's models. The tube works are moderately active, as are the chain, cable and anchor, the heavy edge tool, and the bolt and nut industries. The rolling stock establishments are well employed, but the constructional engineering yards lack really substantial contracts. The immediate outlook for industry generally in the Midland area is best described as uncertain.

Raw Iron.

The strongest position in the market is held by blast-furnacemen, who have no fear of competition and who have contracts on their books which will absorb the greater part of their output to the end of the year. There has been no apparent falling off in demand for foundry iron and specifications come in regularly against contracts. It is believed that the basis rates confirmed by the Association of Pig Iron Producers recently will prevail until the end of January next. If furnacemen can get a premium on the basis rate they will, of course, be at liberty to do so. Whether or not a premium will be demanded depends to some extent on fuel. Furnace coke is still difficult to get in adequate quantities, and those buyers who are having to make new contracts are called upon to pay round about 18s. per ton, or 1s. 6d. to 2s. per ton more than the price paid under their old contracts. Furnacemen are naturally anxious as to the future. Consumers, however, are not moved by the precarious outlook with regard to fuel, and they are not buying further forward than is absolutely necessary to secure necessary supplies to the end of the year. Northamptonshire and Derbyshire smelters have no difficulty in disposing of their output at basis rates. The demand for basic pig having receded, those interested in the iron trade are wondering whether the furnaces which some time ago were diverted from the production of forge and foundry grade iron to basic will return to their normal employment. Should this prove to be the case there would be a possibility of the balance of supply and demand being upset and furnacemen would not continue to hold the strong position they now do.

Finished Iron.

The demand for Staffordshire marked bars at £12 10s. per ton is well maintained and the mills are regularly employed. Conditions in the Crown bar section continue unsatisfactory, little, if any, progress having been made towards establishing a higher and more remunerative level of prices. A number of the large works persist in their effort to obtain £10 7s. 6d. for their product, but others would do business at £10. Internal competition in this branch is as keen as ever. There is no change in the situation regarding nut and bolt bars, and wrought iron tube strip. In the former business is dull, in the latter, bright. Values are unaltered from last week. Staffordshire ironmasters are in agreement with Colonel J. S. Trinham, director of N. Hingley and Sons, Ltd., and of the Harts Hill Iron Company, that there is sufficient puddling capacity in this country to deal with the whole of the home and export demand for wrought iron without having to import any material from abroad. There is a potential market in this country, according to the Colonel, for about 600,000 tons of wrought iron annually, and a further potential colonial market for, probably, 100,000 tons annually. Of the latter this country was being deprived of more than half by continental competition. In 1924 home consumption of wrought iron was 669,000 tons, and imports accounted for 38·1 per cent. of the home consumption. In the first six months of this year imports were 41·5 per cent. of the home consumption. This was a considerable improvement over the corresponding figures for 1926 and 1927, imports in these years being 60 per cent. and 53 per cent. respectively of the home consumption, but it still represented a very serious threat to employment in the British wrought iron industry.

Steel.

Steelmasters who favoured an increase in selling rates of finished steel as an offset against the higher prices they are now called upon to pay for pig iron and fuel, were disappointed when last week the Steelmasters' Association decided to reaffirm exisiting prices. The no-change attitude adopted commends itself, however, to consuming engineers in this district, who affirm that stability is the main thing needed at date. The recent intensifying of foreign competition has undoubtedly weighed with the Association, which is aware of the inroads made into the trade by its foreign rivals. It is noted with satisfaction that reaction has definitely begun in the continental market. This week in Birmingham former offers have been withdrawn and quotations for joists have been raised 1s. 6d. to 2s. per ton, while in the semi-finished branch prices have been raised by 2s. and 2s. 6d. per ton. Large orders have recently been placed for foreign bars, strip, billets, joists and sections on account of the very low prices at which they have been obtainable, and now that prices are on the upgrade few orders are being given out. Users are not to be stampeded into buying large tonnages for stock. They are not at all sure that the upward movement will continue. The disparity between native and foreign prices is still very wide, and steelmasters here are experiencing considerable difficulty in getting enough orders to maintain the present turnover. At the beginning of September steelmakers had good order books and a reasonably bright outlook. New orders have not, however, come in as anticipated, and as contracts are worked off the position at the mills becomes more and more disquieting. Constructional engineers are only making a moderate demand for the heavier sizes of steel, but the call for cutting steel and stainless steel is good. Native angles and joists stand at £8 2s. 6d., tees £9 2s. 6d., ship, bridge and tank plates at £8 17s. 6d., less rebate, to consumers of British steel only. Boiler plates command £9 12s. 6d., and Staffordshire hoops £10. Re-rollers want £8 2s. 6d. upwards for small bars, and billets are obtainable at £6 5s. upwards. The position of continental material is being closely watched.

Cast Iron Research.

The Midland area, in which there are more iron foundries than in any other part of the kingdom, is keenly interested in the British Cast Iron Research Association and appreciative of the useful work it has done during the past five years in the scientific elucidation of problems relating to the progress of the industry. The Association is now seeking to assist members in putting to practical uses the results of its research work, and it will no doubt find Midland foundrymen ready and willing, where possible, to adopt its suggestions. It is noted with interest that during the year 1928–29 over five hundred analyses were conducted in the chemical laboratory. Work was done not only in pig, grey, malleable and chilled irons, but on ores, slags, refractories, coal and coke, and a wide range of special elements often added to cast iron. In the mechanical testing laboratory some three thousand tests were made.

Galvanised Sheets.

The weakness in the galvanised sheet trade persists. Makers quote £13 per ton, as a basis for 24-gauge galvanised corrugated sheets, but there seems little doubt that a figure half-a-crown below this would be readily accepted in the event of business being forthcoming. Demand is very quiet both on home and export account, the overseas orders received early last week being more or less isolated lots.

Scrap.

The steel scrap position is quiet and unchanged. Birmingham merchants report that South Wales consumers are practically off the market. They have adequate stocks and the falling-off in business at the tinplate works is telling against the depletion of these stocks. Offers of supplies at cut rates have met with no response.

A £500,000 Railway Reconstruction Scheme.

I am given to understand that the Great Western Railway Company has adopted a scheme to reconstruct and modernise its locomotive repair shops at Stafford-road, and the Herbert-street goods depôt at Wolverhampton, at a cost of nearly £500,000. The main feature of the proposed plans for the locomotive sheds is the building of a new engine-erecting shop. The new shop will be approximately 450ft. long and will consist of three bays of 63ft. Four new 50-ton cranes are, I learn, to be installed. The reconstruction of the goods depôt includes the provision of a three-floor warehouse and the installation of the latest electrical appliances.

Railway Wagon Contracts.

The Birmingham Railway Carriage and Wagon Company, of Smethwick, the Metropolitan-Cammell Carriage, Wagon and Finance Company, of Saltley, and S. J. Claye and Co., of Long Eaton, are each to supply the London and North-Eastern Railway Company with one hundred wooden-framed mineral wagons, each of 12 tons carrying capacity and of the Railway Clearing House standard design.

Unemployment.

A welcome decline of 1900 in the unemployment figures for the Midlands area is this week recorded. The total for the area is reduced to 157,261, of whom 54,114 are temporarily without work. In Birmingham, Coventry, and all the Black Country towns there are decreases, but slight advances are shown at Derby, Leicester, Northampton, Nottingham, Leamington and Warwick, and Peterborough. Of the total unemployed 118,255 are men, 33,218 women, 3100 boys and 2688 girls.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

The Industrial Outlook.

THE situation in the engineering industry in this part of the country is reviewed as follows by the Manchester Chamber of Commerce in the course of a survey of general industrial conditions. "A good many engineering firms are doing better than they were a year ago, and some are really well employed. Constructional engineers are looking forward hopefully to getting numerous orders in connection with the road-making and bridge-building schemes which have been outlined, principally to provide employment. Textile machinists are doing little for the home manufacturing trade, but a moderate amount of work is going on for other countries which are enlarging their productive capacity. Electrical engineers are generally fairly well employed, and some locomotive builders are getting a good many orders. Machine tool makers continue to be well engaged."

Elevators for South America.

Rumours have been current locally during the past few days to the effect that Henry Simon, Ltd., of Manchester, was in negotiation with the Argentine Government for the construction of a chain of grain elevators across the Argentine. The matter has now been cleared up by Mr. E. D. Simon, head of the firm, who has just returned to this country from a short trip to Brazil and Argentina. Mr. Simon states that his firm is at present building important elevators at Santos, Buenos Aires and Bahia Blanca, which will provide considerable employment at the company's works at Cheadle Heath, near Manchester, for the next year or two. These are the only terminal elevators at present being built in South America. During the last eighteen months or so there has been a great deal of talk concerning the building of a national system of grain elevators in the Argentine, and a Government Committee reported under the last President in favour of such a scheme. Mr. Simon, however, says he is in a position to state authoritatively as a result of interviews with the Argentine Minister of Agriculture and with the President of the Republic that the whole matter has been deferred for further consideration.

£1,000,000 for New Roads.

Road schemes which are estimated to cost about £1,000,000 have just been approved by the Cheshire County Council, and it is stated that the Ministry of Transport will meet 75 per cent. of the cost.

Victim of Colliery Concentration.

Clifton Hall Colliery, Pendlebury, now under the control of Manchester Collieries, Ltd., but formerly owned by Andrew Knowles and Sons, Ltd., was closed down last week-end. It is officially explained by Manchester Collieries, Ltd., that it has decided upon a policy of concentration, by which it is hoped to get other pits working. About 500 men were employed at Clifton Hall, which is the third colliery in the district to be closed during the last year or two.

Personal.

Mr. James Parr, the secretary of the Manchester Steam Users' Association, made a presentation on Monday to Mr. Joseph Howard, who has retired after forty-eight years' service with the Steam Users' Association as an engineer-surveyor.

Non-ferrous Metals.

The weakness in the market for non-ferrous metals has not yet run its course, and during the past week further sharp declines have occurred in all sections. The lower levels at which tin has been available have attracted rather more interest in the metal, although much of the buying has been on speculative account. Even so, however, it has not been sufficient to stem the tide, and prices current are roughly £4 a ton below the levels of a week ago. At which point the trend of the curve will change is problematical, but it remains to be stated that interests are still be to found who are ready to talk the metal down to lower levels. Prices in the copper section have been subject to considerable fluctuation, but, although very much lower on balance for the week, values ruling at the moment of writing are better than the worst. There has been no lack of movement in copper, but, as with tin, a great deal of it has been for speculative purposes. Compared with a week ago, quotations for standard brands are about £2 5s. a ton lower. Events in the case of spelter have not been inspiring, and consumers are still inclined to exercise caution. This metal has continued the movement which has gone on almost without check since the beginning of June, when values were about 30 per cent. higher than they are now, the latter setting up a new "low" for about sixteen years. Partly in sympathy with spelter, but partly due to bigger supplies, lead also has suffered a serious decline, although in the aggregate a fair amount of business has been transacted.

Iron and Steel.

Except that there has been little appreciable falling off in the rate at which pig iron is going into consumption in this district, the iron and steel markets locally are inclined to dullness in most sections. The foundries are showing little anxiety to enter into further commitments for raw material and new business this week has been of decidedly modest dimensions. Staffordshire No. 3 is quoted for delivery equal to Manchester at 77s. per ton, with Derbyshire makes at about the same figure. There has been no alteration in the price position of either Scottish iron or hematite, although sales have been slow on this market. Scottish makes are quoted at from 92s. 6d. to 93s. 6d. per ton, and West Coast hematite at about 90s., both delivered in this district. Inquiry for Lancashire bar iron is no better than before, but values keep up at £10 15s. per ton for Crown quality material and £9 15s. for No. 2. The tendency in the steel market this week has been towards increased quietness, due, in a large measure, to unsatisfactory conditions in constructional engineering, the requirements of most firms in this branch gradually declining. Locomotive builders, however, keep fairly busy, and are taking good quantities of plates and other materials, with small bright drawing bars also a reasonably active spot. Re-rollers meet with a poor demand, and although their prices have been maintained there is a certain amount of evidence of undercutting by holders of second-hand parcels. One or two

fair orders for imported steel have been reported, but, generally speaking, buying interest in this section is slow.

BARROW-IN-FURNESS.

Hematite.

There is nothing fresh to report about the North-West hematite pig iron market, which continues to be firm in tone. Trade is comparatively good, and makers are in a fairly sound position as to orders, being booked well forward. No signs are noticeable of any falling off in the market, which seems to have become very steady. In better qualities of iron of stated analysis there is a good business and trade with America and the Continent is mostly in this class of iron. The iron ore trade is well maintained and contracts for native ore with makers in Scotland and elsewhere are fairly substantial. Local demands do not vary much, as the twelve furnaces have fixed requirements. Better qualities on occasions require more local ore of high percentage. Foreign ore is in steady demand. The steel trade is dull and orders are few and hard to secure in view of the keen competition. The hoop mills are well employed.

Coming Events.

Next week there will be two interesting events. There will be launched from Vickers-Armstrongs, Barrow, a Siamese river gunboat. This craft, although not of heavy tonnage or big draught, possesses many remarkable features which will make her an exceptional vessel for river patrol. The extension to the Barrow Corporation power station will be opened, when the Mayoress is to start the new 6000-kW steam turbine generators which have been installed in view of the increasing demand for power locally. The cost of the installation is about £60,000.

SHEFFIELD.

(From our own Correspondent.)

Basic Steel Weaker.

THE basic steel department, which for a good while has been the busiest in the Sheffield district, so far as those engaged on the production of material for ordinary commercial purposes are concerned, is now showing signs of weakness. The works had been well employed until last month, but recently new orders have not been coming to hand in sufficient volume to replace those which were executed, and two large furnaces, at any rate, have been stopped. The inquiries are on a disappointing scale, and suggest some decline of confidence in the future. Reasons put forward as probably accounting for this state of things are the financial collapse in the United States, following upon the Hatry failure. It is suggested that these events have had a bad influence upon commerce generally, and that Sheffield, as well as other places, is feeling the adverse effects. There is also an increase in the importation of crude steel from the Continent to be taken into account, but that does not affect Sheffield in any large degree. In Lincolnshire, activity at the iron and steel works is being maintained, but there, again, there is a falling off in inquiries, in both number and weight of material concerned.

Other Departments.

There is no improvement to report on the acid side of the steel trade. The railway steel branch at some of the works is better employed than usual, on account of the recent placing of large South African orders, and one firm is very active on special buffers, and has good prospects of continued work. The general demand for axles, tires, and springs, however, is still very unsatisfactory, largely because of the economical policy pursued by the British railway companies. A certain amount of armour-plate work is on hand in connection with a Spanish order, but the armament departments generally are very slack, as they have been for a long time. There is a continuance of the good demand for special steels of various classes, on which a number of firms are well employed.

Prices of Material.

Steel prices in this district have been stationary for some time. A rise in foundry pig iron prices in the New Year will not come as a surprise, for the material is somewhat scarce, and producers are refusing to accept business at current rates for delivery after Christmas. A large tonnage of pig iron is being consumed by the Derbyshire pipe foundries, which are busily employed. On the other hand, the light castings foundries are quiet. Tungsten continues dear, and that is causing some concern to makers of high-speed steel, twist drills, and cutters. When the price rose sharply earlier in the year, most of the high-speed steel firms were bought well ahead, and they have since been holding off the market in the hope that the situation would ease. Smaller firms, however, who had not anticipated the rise, found themselves in difficulty, as selling prices of finished steel have not been advanced, and they were thus unable to recoup themselves for their increased outlay. Now some of the contracts have expired. So far as can be seen, there is no likelihood of a fall in the present price of tungsten, which represents a substantial increase in the cost of producing the finished articles.

The Lighter Trades.

There is still much activity in the cutlery and electro-plate trades in producing for the special Christmas demand. Orders continue to arrive fairly regularly, and some firms are exceptionally busy. Part of the demand comes from large works, which are buying their usual Christmas gifts for customers, and there are also some capital special contracts on hand for cutlery and plate for coupon and advertising purposes. The demand for best qualities of cutlery is only on the quiet side. A fair amount of trade is being done with overseas markets. The trade in safety razor blades is still very large, but hardly equal to what it has been, and some makers have reduced their output. The Government contract for these blades has again been secured by Thos. Ward and Sons, Ltd., of Sheffield. The low prices of raw silver still prevail. This condition has encouraged the manufacturers of silver-ware to make up a large quantity of finished goods this year, and there has been a good sale for them. The boom appears to have ended now, however. The factories are not so well employed as they were a month or two ago, and there are large stocks on hand. The demand for engineers' small tools is well maintained, but one hears many complaints as to prices and profits. The file trade is moderately employed, and is showing an improving tendency. There are hopes that as a result of recent political happenings the resumption of trading with Russia on a large scale will be facilitated. A limited amount of business with that country is being done now, and it is believed that substantial orders for files and tools will be offered in the New Year.

Big Derbyshire Road Schemes.

Nowhere in this part of the country have greater road schemes been proposed, with a view to relieving unemployment, than in Derbyshire. At the County Council meeting last week, the Roads and Bridges Committee reported that it had submitted to the Ministry of Transport a five years' programme, including the widening of long stretches of Class I. roads to 60ft., the approximate cost of which was no less than £1,420,500. The Ministry has promised a 75 per cent. grant towards several of the schemes, including one for a proposed by-pass road from Little Eaton to Coxbench, which is to cost £55,000; and it has asked whether the Council would, with similar assistance, undertake the work of widening and otherwise improving the main road from Derby to Manchester, *viâ* Belper and Bakewell. This latter is a very large work, which will involve a cost of nearly £500,000. The Committee is to consider the suggestion of the Ministry. Plans and estimates are being prepared for a widening of the Hathersage to Castleton main road from Glen Brook to the road leading to Hope Station; also estimates for the improvement of the main road leading from Clowne towards Rotherham between Harlesthorpe-road and the Clowne cross roads.

The Burbage Reservoir.

Sheffield City Council has decided to promote a parliamentary Bill to obtain powers for the construction of the Burbage reservoir, to which I referred last week. The reservoir will cost £650,000, towards which the Government will contribute about £300,000. Employment will be found for 500 men for six years.

NORTH OF ENGLAND.

(From our own Correspondent.)

Coal Trade More Prosperous.

THE Northern coal trade, after many lean years, appears to have definitely entered upon more prosperous times. Production in both Northumberland and Durham is now on a scale that has rarely been approached in recent years. It amounts to about 1,130,000 tons a week, or a fifth of the country's production. There are 11,000 more men employed in the Durham pits and nearly 2000 more at the Northumberland mines than there were at the beginning of the year. No one expects that there will be a stoppage at the mines in consequence of the present disagreement over the hours question, but the prospective changes relating to marketing schemes and minimum prices are disturbing to the normal course of trade, which is good and likely to remain so if not upset by outside interference. All competing countries are looking forward to increased business next year, and their prices approximate to those in this district. Northumberland and Durham coal is, however, preferred in many places to that produced on the Continent, and it is confidently felt that the industry, given freedom from any irritating influences, will have a steadily improving course.

Cleveland Iron Trade.

Although business is below normal for this season of the year, a more hopeful feeling prevails in the Cleveland iron trade. Consumers are less reluctant to release orders to cover requirements to the end of the year, but business that is being placed is largely what has been held back in the hope of securing price concessions. Conditions do not admit of reduction in market rates. Indeed, with production costs still rising, quotations seem more likely to advance. There is more stability in the home than in the export trade, but labour troubles are a factor in the unsatisfactory position. The healthy statistical position of the trade enables ironmasters to take a very firm stand, though second hands continue to sell small parcels at below makers' fixed minima. Stocks are low, and output is going steadily into consumption, chiefly at local works. A few sales to Scotland are reported, but export demand continues very light. No. 1 Cleveland pig iron is 75s.; No. 3 G.M.B., 72s. 6d.; No. 4 foundry, 71s. 6d.; and No. 4 forge, 71s.

Hematite Pig Iron.

A blast-furnace, which had been engaged on the production of East Coast hematite pig iron, was put out of operation this week at the Ayresome Ironworks of Gjers, Mills and Co., Ltd., Middlesbrough. It is understood that the furnace is to be re-lined. Home and continental consumers are still in the market, but they hesitate to follow the upward movement in values. Producers, however, are quite well placed as regards orders, and are now markedly disinclined to sell except at figures closer to an economic level than those at which contracts have been arranged recently. Prices are not fixed, but the basis of market rates is not below 78s. for ordinary qualities over the rest of the year. Cost of output is stated to be fully 80s. For supply early in 1930 ordinary descriptions are quoted at 81s., and for delivery over the first quarter of next year 82s. 6d. is asked.

Ironmaking Materials.

Large imports of foreign ore are still coming forward under running contracts, but new business rules on quiet lines. Best Rubio ore is quoted at 24s. c.i.f. Tees. The situation as regards blast-furnace coke is perturbing. Essential local needs are not easily met, and scarcity threatens to be more acute. Makers are desirous of assisting consumers in this district, and are not taking advantage of the opportunity to force up prices. Good medium qualities are 24s. delivered at North-East Coast works.

Manufactured Iron and Steel.

There are few new features of moment in the manufactured iron and steel trade. Manufactured iron producers have quite a lot of work to execute, and hold steadily to late quotations. Semi-finished steel firms are also well sold and have not lowered prices, though they now experience difficulty in securing orders, as foreign products are comparatively cheap. In the finished steel departments continental competition is keen, but there is some improvement in demand for certain types. Shipbuilding requisites find a ready sale, and constructional steel is in improving request.

New Shipbuilding Orders.

William Doxford and Sons, Ltd., of Sunderland, have received orders to build two new cargo vessels, one for a London firm and the other for Scandinavian owners. Two other Sunderland firms—Joseph L. Thompson and Sons, Ltd., and Sir James Laing and Sons, Ltd.—have also each received an order for a ship. These new orders represent an addition of 30,000 tons to the ships already under construction on the North-East Coast. Tees-side's shipbuilding industry has also received a substantial stimulus as a result of a series of orders booked by the Furness Shipbuilding Company, of Haverton Hill. They comprise one for a 16,000-ton twin-screw Diesel tanker, four for 2800-ton steam-driven tankers, one for a 3600-ton Diesel electrically driven vessel, and one for a 3800-ton ocean-going tanker. The whole of these vessels are repeat orders from American and Canadian owners, and all are to be built of British-produced steel, and all but one engined by British engineers.

The Coal Trade.

The Northern coal market has an irregular tendency, mainly caused by the irregular tonnage arrivals and shortage of wagons at the collieries. Many fitters complain about the limited supply of wagons, which prevents the pits working at full pressure, whilst in numerous instances the shortage is caused by the difficulty in getting tonnage into the available loading berths. For best Northumberland steams the demand is fully maintained, but there is no new business placeable except for odd parcels. Up to 16s. 9d. is named for best qualities, but shipment is difficult to arrange, and for January to March next year the owners are marking time, pending the settlement of the marketing schemes. Prices for next year are, therefore, indicated on a nominal basis. Durham best steams are quoted steady at 18s. 6d. for large and 13s. 6d. for small. The gas coal trade is improving. Wear special gas is held at 17s. 3d. to 17s. 6d. Best gas coal is steady at 16s. 9d., and seconds are round about 15s. Coking coals are in ready offer at from 14s. 6d. to 15s. 6d., according to brand. There is a surplus of secondary bunkers, and, with a dull market continuing, prices are on a weak basis, though unchanged. The production of coke in the district is insufficient for requirements and the market for the small quantities available for early shipment is therefore a strong one. Gas coke maintains 25s., ordinary patent coke ranges from this figure up to 26s., and special qualities are 28s. to 32s., according to requirements.

SCOTLAND.

(From our own Correspondent.)

Quiet Outlook.

THERE has been no change of note in the position of the steel, iron and coal trades during the past week. Shipbuilding and railway contracts have been reported, and inquiries are to hand which may eventually prove beneficial to the steel industry, but the amount of business on offer will require to show a substantial increase before the immediate future can be regarded with any marked degree of confidence.

Steel.

The steel works, as a rule, are working below capacity, and in some cases specifications are urgently required. Makers of heavy steel have a fairly regular flow of orders for shipbuilding materials, but there is ample room for improvement in the export turnover. Steel tubes are still comparatively well placed.

Sheets.

The position in the export branch has improved as a result of some good inquiries from the East, and the outlook is considerably better than it was some few weeks ago. Flat and corrugated galvanised sheets have not been too well supported of late, and prices are a shade easier.

Iron.

The bar iron trade is very quiet and holds little promise of an early expansion in business. Almost similar conditions obtain in the re-rolled steel branch of the industry. In the latter the business on offer has decreased to a considerable extent during the past month or two, and owing to keen competition the prices obtained are not always remunerative. Bar iron prices are unchanged, while re-rolled steel bars are quoted in the region of £7 17s. 6d. per ton for home and £7 15s. per ton export.

The demand for pig iron is quiet though steady, and the output with only about twenty furnaces in blast is ample to meet all requirements.

Scrap.

Supplies of scrap are now more easily obtained, and prices as a rule are a shade easier, as follows :—Heavy steel, 72s. 6d.; cast iron machinery, 70s., and heavy basic, 70s. per ton.

Shipbuilding Orders.

It is reported that Lithgows, Ltd., Port-Glasgow, have received a contract to build two motor tankers of 13,5000 tons each for Norwegian owners. These vessels are to be delivered before the middle of next year.

Coal.

Scottish coals for shipment have shown a tendency to become dearer during the past week, especially in the Fifeshire district, where the collieries have benefited from the arrival of a considerable volume of tonnage which had been delayed by bad weather. All coal which had accumulated on railway sidings has been quickly disposed of, and outputs from the collieries are readily taken up, with the result that prices are firmer all round. Lothians steams are stronger owing to increased home demands. Lanarkshire e'ls also are in better home demand, but splints are more easily obtained as a result of a falling off in orders for Italy. In all districts washed materials are very firm and difficult to obtain. Aggregate shipments amounted to 308,301 tons, against 299,819 in the preceding week and 249,714 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

RECENT conditions in both the steam and anthracite sections of the coal trade have been well maintained during the past week. Anthracite coals are particularly scarce, and early this week there were as many as fourteen steamers waiting to berth at Swansea. In so far as steam coals are concerned, it cannot be said that there is any improvement of special account. Collieries still find in many cases a shortage in the demand for large coals, but, on the whole, shipments are keeping up well, considering that tonnage at the disposal of the collieries is by no means adequate. The prospects of the conditions maintaining the existing level at least are bright, as chartering operations continue at a satisfactory level, despite the apparent slowness with which new orders materialise. There is no doubt that a good deal of business is being arranged that does not in the ordinary way come on the market, and this would appear to be especially the case so far as sales to France are concerned, as shipments are heavier and have been for the last month or so than for years previous. Rumours are current that business over next year has been done on a very considerable scale, quite apart from contracts for some of the foreign railways. In the case of the recent inquiry from the Algerian State Railways for about 200,0 0 tons of coal and patent fuel, it is confirmed that orders have been placed for 80,000 tons of coal and 40,000 tons of patent fuel from this district, and that the balance of about 100,000 tons has gone to Germany and France. It is also understood that the British Admiralty authorities have placed orders with a number of the leading collieries for their requirements over next year, estimated to amount to round about 300,000 tons.

Government and Coal Marketing Schemes.

Developments regarding Government action so far as the coal industry is concerned are being eagerly followed. In connection with the coal-marketing scheme for this district the first ordinary meeting of the South Wales Coal Marketing Association was held on Monday. Mr. W. North Lewis was elected chairman and Mr. Norman J. McNeil vice-chairman, and thirty members were appointed to serve on the Executive Committee. .The Association Executive has sent through its secretary a letter of considerable importance to the President of the Board of Trade. This states that the Committee understood that if a district scheme were inaugurated and issued to the colliery owners by October 15th, and if it were subsequently accepted by owners who represented a majority of the output of the district, there would be no interference subsequently by the Government beyond making the scheme legally binding on all the coalowners in the district. Acting on this assumption and in good faith, the Committee completed and issued a scheme to all the South Wales owners early in October. That scheme has now been adopted by owners the output of whose collieries is 82 per cent. of the output of the coalfield, and a deed of association embodying the scheme has been signed by them. The Executive Committee points out that several companies signed the deed on the distinct understanding that the Government would not intervene if the trade framed its own scheme. Any proposals of the Government inconsistent with or any interference by the Government superimposed upon the South Wales scheme, therefore, constitutes not only a distinct breach of the understanding which the Government allowed to be made at the inception of the discussions with the coal trade, but would entail alterations of such a nature that unnecessary confusion and serious delay would arise. The Association consequently protests against such proposals of the Government as are inconsistent with the conception of the South Wales scheme, and expresses the hope that they will not be pursued.

Important South Wales Coal Merger.

Although official details are still unobtainable, it is disclosed that negotiations are nearing completion for the merging of colliery and coal-distributing enterprises in this district on a great scale, resulting in undertakings owning sixty pits and employing 35,000 to 40,000 workmen in the steam coal area coming under one direction. These negotiations are between Guest, Keen and Nettlefolds, Ltd., in so far as their Abercynon collieries are concerned and the Cambrian group. D. Davis and Sons, Ltd., the Bwllfa and Cwmaman Collieries, Ltd., Llewellyn (Nixon), Ltd., Llewellyn (Plymouth), Ltd., Llewellyn (Cyfarthfa), Ltd., Troedyrhiw Coal Company, Ltd., D. R. Llewellyn and Sons, Ltd., Aberdare Graig Coal Company, Ltd., Duffryn Rhondda (1929), Ltd., Cynon Colliery Company, Ltd., and the well-known coal-sales and coal-exporting undertaking of Gueret, Llewellyn and Merrett, Ltd. It is understood that a new company is to be formed with a capital of about £10,000,000, and holders of shares in the above-mentioned companies will be offered shares in the new undertaking in exchange for their holdings. Although not definitely settled, the title of the new undertaking will be in all probability Associated Welsh Collieries.

Swansea and Proposed New Lock.

The Great Western Railway Company has advised the Swansea Chamber of Commerce that a scheme for the construction of a new lock at the Swansea docks has been submitted to the Advisory Committee appointed by the Government under the Development (Loans, Guarantees and Grants) Act, 1929. The existing lock serves not only the King's Dock, but also the Prince of Wales and the Queen's docks, and if by any chance anything should happen to block the entrance lock, it would mean that shipping for the whole of the Swansea docks would be held up. The Swansea Chamber of Commerce recently emphasised the importance of an alternative entrance being provided. The proposed scheme will cost, it is estimated, approximately £1,000,000.

Sea-borne Traffic.

The G.W.R. Company's returns of sea-borne traffic at the ports in this district under its control show that for the four weeks ended October 27th imports and exports combined amounted to 3,061,653 tons, as against 3,012,448 tons for the preceding month, and with 2,688,112 tons for the corresponding period of last year. Taking the whole of this year to October 27th, imports and exports came to 31,667,261 tons, as compared with 28,750,285 tons for the same period of 1928 and with 31,467,082 tons for the same period of 1927.

Current Business.

The tone of the market generally displays no material change. Large coals are irregular, the demand being comparatively quiet, except in the case of dry qualities, which remain very firm and command 1s. to 1s. 6d. above the schedule minimum figures. Small coals and sized descriptions also maintain a very good tone, and patent fuel is having quite a busy time, stems being difficult to arrange for the next fortnight. Coke meets with a steady demand and pitwood keeps round about 28s. 3d. to 28s. 9d.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. W. B. LAKE, senior director of Lake and Elliott, Ltd., Braintree, has been elected a member of the Council of the British Cast-Iron Research Association.

WE are asked to state that the Anglo-Russian Committee's report on the visit of the British trade delegation to Russia can be obtained from the Anglo-Russian Committee, 4, Lloyd's-avenue, London, E.C. 3.

THE GENERAL ELECTRIC COMPANY, Ltd., asks us to announce that the telephone number of its Ipswich branch has been changed from Ipswich 2379 to Ipswich 3771 (two lines).

BRUCE PEEBLES AND CO., Ltd., of Edinburgh, ask us to announce that they have been granted by Brown Boveri and Co., Ltd., of Baden, Switzerland, the sole licence for the manufacture and sale in Great Britain of the mercury-arc rectifiers, with which the name of the latter firm is associated.

MR. E. J. SILCOCK, M. Inst. C.E., F.S.I., asks us to announce that he has entered into partnership with Mr. Christopher Simpson, P.A.S.I., a former pupil and assistant, and that they will continue to practise as consulting civil engineers and surveyors at 25, Victoria-street, Westminster, and 10, Park-row, Leeds.

VICKERS LTD. asks us to announce that Mr. G. R. T. Taylor has resigned his appointment as deputy chairman of the company, but retains his seat on the board. Mr. G. G. Sim, C.S.I., C.I.E., has been appointed deputy chairman in his place. Mr. J. Reid Young, C.A., has been appointed secretary to the company in place of Mr. Sim.

LAUNCHES AND TRIAL TRIPS.

JANETA, single-screw steamer; built by Barclay, Curle and Co., Ltd., to the order of the Glasgow United Shipping Company; dimensions, 402ft. by 54ft. 9in. by 31ft.; to carry cargo. Engines, triple-expansion, 24in., 40in. and 67in. by 51in. stroke, pressure 200 lb. per square inch; constructed by the builders; launch, October 11th.

MID OCEAN, twin-screw passenger tender; built by Blythswood Shipbuilding Company, Ltd., to the order of the Bermuda and West Indies Steamship Company, Ltd.; dimensions, 190ft. by 33ft. 6in. by 16ft.; to carry about 600 passengers. Engines, triple-expansion; constructed by J. G. Kincaid and Co., Ltd., Greenock; a speed of 14 knots was attained on trial trip, October 16th.

ANGLO-SWEDE, motor ship; built by Sir W. G. Armstrong, Whitworth and Co. (Shipbuilders), Ltd., to the order of Rederiaktiebolaget Tanker, of Stockholm, Sweden; dimensions, 460ft. by 59ft. 7in. by 33ft. 7in.; to carry 11,000 tons oil in bulk. Engines, Polar Diesel engine; launch, October 18th.

TACOMA CITY, steamship; built by Wm. Gray and Co., Ltd., to the order of Sir William Reardon Smith and Sons, Ltd., Cardiff; dimensions, 400ft. by 54ft. 3in. by 28ft. 0½in.; to carry cargo. Engines, triple-expansion, 25in., 42in., 70in. by 48in. stroke, pressure 200 lb. per square inch; constructed by the builders; trial trip, October 18th.

KAIMIRO, steamship; built by Cammell Laird and Co., Ltd., to the order of Union Steamship Company of New Zealand Ltd.; dimensions, 284ft. by 46ft. by 21ft. Engines, triple-expansion; constructed by the builders; trial trip, recently.

GLOFIELD, steel screw steamer; built by Craig, Taylor and Co., Ltd., to the order of Humphries (Cardiff), Ltd.; dimensions, 414ft. by 53ft. 6in. by 35ft. 6in.; to carry cargo. Engines, triple-expansion, 25½in., 42in., 70in. by 48in. stroke, pressure 180 lb. per square inch; constructed by Blair and Co., Ltd.; launch, October 21st.

BLINJOE, steamship; built by The "De Maas" Shipbuilding Company, to the order of the Royal Packet Company, of Amsterdam; dimensions, 252ft. by 40ft. by 15ft. 6in.; to carry cargo. Engines, 4-cylinder Lentz; 800 mm. by 370 mm. by 370 mm. by 800 mm. by 800 mm. stroke; constructed by Stork Bros., Hengelo, Holland; launch, recently.

KITTY TAYLOR, steamship; built by Sir W. G. Armstrong, Whitworth and Co. (Shipbuilders), Ltd., to the order of Eros Steamships Ltd.; dimensions 407ft. by 53ft. 9½in. by 36ft. 3in. to carry 8700 tons. Engines, triple-expansion, 26in., 43in., 72in. by 48in. stroke; pressure, 180 lb. per square inch; constructed by the builders; trial trip, recently.

CONTRACTS.

UNDERFEED STOKER COMPANY, Ltd., has received from Imperial Chemical Industries, Ltd., an order for six vibro conveyors made on the Schenck-Heymann system. These conveyors are to be of special design and are to be capable of handling fine cement dust at a temperature of approximately 400 deg. Cent., with capacities up to 30 tons per hour.

FARADAY HOUSE ELECTRICAL ENGINEERING COLLEGE.—Sir Hugo Hirst, G.B.E., will give an address to the students of Faraday House Electrical Engineering College on Monday, November 18th, at 11.30.

INSTITUTION OF GAS ENGINEERS.—The Institution of Gas Engineers held a dinner at the Criterion Restaurant on Wednesday, the 13th inst., to commemorate the granting of a Royal Charter to the Institution. Mr. C. S. Shapley, the President, said that gas was now supplied in this country to 9,000,000 houses, so that some 36,000,000 people must be dependent on gas for lighting or heating, yet the deaths which can be attributed to gas poisoning amounted to only 136 during last year. He also said that the research work carried on by the gas companies was unsurpassed in extent by that of any other industry. Sir David Milne Watson, in proposing the toast of "The Institution," said that he represented the oldest chartered institution in the gas industry, the Gas Light and Coke Company, which was granted a charter by George III. in 1812. "Kindred Associations" was proposed by Sir Arthur Duckham, and was responded to by Mr. J. A. Reavell, President of the Institution of Chemical Engineers; by Mr. C. A. Goodall, Chairman of the Society of British Gas Industries; and by Brigadier-General Magnus Mowat, Secretary of the Institution of Mechanical Engineers. The toast of "The Visitors" was proposed by Mr. H. E. Copp, and was acknowledged by Mr. Arthur Hayday and Sir Albert Ball.

THE HAMS HALL POWER STATION.—In our article on the Hams Hall power station, appearing in our last issue, we omitted to mention that the Atritor coal pulverisers were made by Alfred Herbert, Ltd., of Coventry. As is well known, the Atritor is a unit pulveriser, into which the coal in the form of small low-grade screenings is fed direct from overhead bunkers. On entering the pulverising chamber in the Atritor the coal is first beaten by swinging hammers through a screen from which it passes in a coarsely granulated form to the pulverising zone. The pulverising elements consists of alternate rings of moving pegs and fixed pegs, and the moving pegs, travelling at very high speeds, set up vortices and eddies in the coal dust which cause the particles to act on each other by attrition until they are reduced to fine powder, which is blown directly into the combustion chamber of the boiler. During the pulverising process the coal is dried by hot air drawn from heaters placed in the boiler flue outlet. No pulverised coal is stored, the amount fed into the pulverisers at any moment being in accordance with the requirements of the boilers at that time. The amount of coal passing into the pulverisers is regulated electrically from a switchboard on the firing platform, and the whole coal supply to the boilers is therefore under the control of one engineer.

THE ASSOCIATION OF CONSULTING ENGINEERS.—The annual dinner of the Association of Consulting Engineers was held at the St. Stephen's Club, Westminster, on the evening of Wednesday, November 13th, and it was in every way successful. Mr. N. G. Gedye, who is Chairman of the Committee of the Association, presided over a company of upwards of 150 members and guests. The Association has always been happy in its choice of speakers; and it was never more so than on the present occasion. There was this year an innovation in the toast list. One of the toasts—it was in fact the toast of the evening and came immediately after that of "His Majesty the King"—was that of "The High Court of Parliament," which was eloquently put forward by Mr. S. C. Lewis, and which elicited equally eloquent replies from Lord Darling, as representing the House of Lords, and Sir Thomas Robinson, as a member of the House of Commons. Mr. Godfrey M. C. Taylor, in a vein strongly reminiscent of his father—the late Mr. Midgley Taylor—gave the toast of "The Guests," which was responded to by Sir John Anderson, of the Home Office, and Dr. S. Z. de Ferranti, F.R.S. The final toast—that of "The Association"—was propounded by Mr. Loughnan Pendred, who was in bantering mood, and replied to by the Chairman. Altogether it was a most enjoyable evening.

ROYAL INSTITUTION OF GREAT BRITAIN.—The Christmas lectures adapted to a juvenile auditory will this year deal with "How Things were Done in Ancient Egypt," and will be delivered by Mr. S. R. K. Glanville, of the Department of Egyptian and Assyrian Antiquities, British Museum. The first lecture will be delivered on Saturday, December 28th, and will be entitled "The Elementary Use of Nature." Lecture II., Tuesday, December 31st, will be on "Making a Home;" Lecture III., Thursday, January 2nd, "Building in Stone;" Lecture IV., Saturday, January 4th, "Boats and Furniture;" Lecture V., Tuesday, January 7th, "The Workshops;" and Lecture VI., Thursday, January 9th, "Hieroglyphs." Owing to the reconstruction of the Lecture Theatre at the Institution building, these lectures will be given, by courtesy of the Council, in the Lecture Theatre of the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2. Tickets for these lectures, for which no charge will be made, may be had on application to the Royal Institution. Members may attend without ticket. A certain number of tickets will be reserved for issue to members only until December 18th. Early application is desirable. The Friday evening discourses will begin on December 6th, when Mr. Hugh Walpole will discourse on "The Novel and the Creative Spirit." On December 13th, Miss D. A. E. Garrod will discuss "Cave Excavation in the Near East," while on December 20th Monsieur Emile Cammaerts, LL.D., will lecture on "Italian and Flemish Art: A Contrast." These discourses begin at 9 p.m. During the reconstruction of the Lecture Theatre they will be given in the Newspaper Room on the ground floor at the Institution building in Albemarle-street. Owing to the limited accommodation special numbered (not reserved) tickets will be issued (for members as well as guests) for each discourse.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	19/6 to 22/-
(1) Spanish	24/- to 26/-
(1) N. African	24/- to 26/-
N.E. Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	24/9

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	4 0 0	—
No. 1 Foundry	3 18 6	—
No. 3 Foundry	3 16 0	—
N.E. Coast—		
Hematite Mixed Nos.	3 18 0	3 18 0
No. 1	3 18 6	3 18 6
Cleveland—		
No. 1	3 15 0	3 15 0
Silicious Iron	3 15 0	3 15 0
No. 3 G.M.B.	3 12 6	3 12 6
No. 4 Foundry	3 11 6	3 11 6
No. 4 Forge	3 11 0	3 11 0
Mottled	3 10 6	3 10 6
White	3 10 6	3 10 6
Midlands—		
(3) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
„ „ Foundry	—	—
(3) Northampton—		
Foundry No. 3	3 15 0	—
Forge	3 11 0	—
(1) Derbyshire—		
No. 3 Foundry	3 18 6	—
Forge	3 14 6	—
(3) Lincolnshire—		
No. 3 Foundry	3 13 6	—
No. 4 Forge	3 9 6	—
Basic	—	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 7 6 (*a*) / 4 9 6 (*b*) / 4 13 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
Lancs.—		
Crown Bars	10 15 0	—
Second Quality Bars	9 15 0	—
Hoops	13 0 0	—
S. Yorks.—		
Crown Bars	11 0 0	—
Best Bars	11 10 0	—
Hoops	12 0 0	—
Midlands—		
Crown Bars	10 0 0 to 10 10 0	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	—
Gas Tube Strip	11 2 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 0 0	10 0 0
Ship Plates, ½in. and up	8 7 6	7 12 6
Sections	8 2 6	7 2 6
Steel Sheets, ¼in.	9 0 0	8 15 0
Sheets (Gal. Cor. 24 B.G.)	13 7 6	13 7 6

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 12 6	—
Angles	8 2 6	—
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 2 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	—
Billets	6 15 0 to 9 10 0	—
Manchester—		
Bars (Round)	9 2 6	—
„ (Small Round)	8 5 0 to 8 7 6	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	9 17 6	—
Sheffield—		
Siemens Acid Billets	9 10 0	—
Hard Basic	9 2 6 and 9 12 6	—
Intermediate Basic	7 12 6 and 8 2 6	—
Soft Basic	7 0 0	—
Hoops	9 15 0 to 10 5 0	—
Soft Wire Rods	8 2 6	—
Midlands—		
Small Rolled Bars	8 2 6 to 8 15 0	—
Billets and Sheet Bars	6 5 0 to 6 12 6	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	12 17 6 to 13 2 6	—
Angles	8 2 6	—
Joists	8 2 6	—
Tees	9 2 6	—
Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 12 6	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	18/9 to 19/-
Block Tin (cash)	174 15 0
„ (three months)	178 0 0
Copper (cash)	67 0 0
„ (three months)	67 2 6
Spanish Lead (cash)	21 2 6
„ „ (three months)	21 11 3
Spelter (cash)	20 10 0
„ (three months)	21 2 6
Manchester—	
Copper, Best Selected Ingots	74 15 0
„ Electrolytic	83 15 0
„ Strong Sheets	110 0 0
„ Tubes (Basis Price), lb.	0 1 3
Brass Tubes (Basis Price), lb.	0 1 1
„ Condenser, lb.	0 1 3
Lead, English	23 5 0
„ Foreign	21 15 0
Spelter	21 7 6
Aluminium (per ton—raw in o:)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit
Tungsten Metal Powder	3/6½ per lb.	
Ferro Tungsten	3/3½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/6
„ „ 6 p.c. to 8 p.c.	£22 0 0	6/6
„ „ 8 p.c. to 10 p.c.	£21 17 6	6/-
„ „ Specially refined		
„ „ Max. 2 p.c. carbon	£33 0 0	10/-
„ „ „ 1 p.c. carbon	£38 0 0	15/-
„ „ „ 0·70 p.c. carbon	£39 0 0	15/-
„ „ „ carbon free	1/2 per lb.	
Metallic Chromium	2/6 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home	
	£13 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 10 0 scale 5/- per unit	
„ „ 75 p.c.	£19 0 0 scale 7/- per unit	
„ Vanadium	12/10 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£170 to £175	
Ferro Cobalt	9/4 per lb.	

FUELS.

SCOTLAND.

(*Prices not stable.*)

Lanarkshire—	Export.
(f.o.b. Glasgow)—Steam	14/-
„ „ Ell	16/3
„ „ Splint	16/6 to 18/-
„ „ Trebles	16/6
„ „ Doubles	16/-
„ „ Singles	14/- to 14/6
Ayrshire—	
(f.o.b. Ports)—Steam	14/6
„ „ Jewel	16/6
„ „ Trebles	17/6
Fifeshire—	
f.o.b. Methil or Burntisland—Steam	13/9 to 15/6
Screened Navigation	17/6 to 18/6
Trebles	18/- to 19/6
Doubles	16/- to 17/-
Singles	15/-
Lothians—	
(f.o.b. Leith)—Best Steam	14/6
Secondary Steam	13/9
Trebles	17/6
Doubles	16/-
Singles	14/-

ENGLAND.

	Inland.
(8) N.W. Coast—	
Steams	21/6 to 23/-
Household	38/- to 51/-
Coke	27/6
Northumberland—	
Best Steams	16/9 to 17/-
Second Steams	15/6 to 16/-
Steam Smalls	10/- to 10/6
Unscreened	13/- to 13/6
Household	25/- to 37/-
Durham—	
Best Gas	16/6 to 16/9
Second	15/- to 15/3
Household	25/- to 37/-
Foundry Coke	25/- to 30/-
Sheffield—	
Best Hand-picked Branch	26/6 to 28/-
Derbyshire Best Bright House	21/- to 23/-
Best House Coal	20/6 to 21/6
Screened House Coal	18/6 to 20/-
„ „ Nuts	16/6 to 18/-
Yorkshire Hards	15/6 to 17/-
Derbyshire Hards	15/6 to 17/-
Rough Slacks	9/- to 10/-
Nutty Slacks	7/6 to 8/6
Smalls	3/- to 5/-
Blast-furnace Coke (Inland)	14/6 at ovens
Furnace and Foundry Coke (Export), f.o.b.	23/- to 24/-

(9) SOUTH WALES.

Cardiff—	
Steam Coals :	
Best Smokeless Large	20/- to 20/3
Second Smokeless Large	18/9 to 20/-
Best Dry Large	19/6 to 21/-
Ordinary Dry Large	19/- to 19/6
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/9 to 18/3
Ordinary Eastern Valley Large	17/6 to 17/9
Best Steam Smalls	14/3 to 14/6
Ordinary Smalls	13/- to 14/-
Washed Nuts	19/6 to 30/-
No. 3 Rhondda Large	20/3 to 21/-
„ „ Smalls	15/6 to 16/-
No. 2 „ Large	17/3 to 17/6
„ „ Through	15/6 to 16/6
„ „ Smalls	14/3 to 14/9
Foundry Coke (Export)	32/6 to 37/6
Furnace Coke (Export)	30/- to 31/-
Patent Fuel	22/- to 22/6
Pitwood (ex ship)	28/6 to 29/-
Swansea—	
Anthracite Coals :	
Best Big Vein Large	35/- to 37/6
Seconds	28/6 to 30/6
Red Vein	24/- to 27/6
Machine-made Cobbles	42/- to 45/-
Nuts	42/6 to 45/-
Beans	24/- to 26/-
Peas	19/6 to 20/-
Breaker Duff	10/3 to 10/6
Rubbly Culm	13/3 to 13/9
Steam Coals :	
Large	18/- to 19/-
Seconds	17/- to 18/-
Smalls	12/- to 13/9
Cargo Through	15/6 to 16/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate : Joists (minimum), 12/6 ; Ordinary Ship, Bridge and Tank Plates and Sections, 10/- if home consumers confine purchases from associated British Steel Makers.

French Engineering Notes.

(From our Correspondent in Paris.)

The Steel Cartel.

THERE is a general impression that the steel trade has been saved from a threatened collapse by the action of the Executive Committee of the International Steel Union in decreeing a reduction of output. The immediate effect has been to show that the Union is a factor to be reckoned with, and those foreign speculators who had been waiting for a collapse in prices are now buying, with the result that prices all round have improved. Nevertheless, it is by no means sure that the improvement can be maintained in view of the diminishing consumption. The industrial activity in France, while continuing satisfactory on the whole, has become less general, and in the motor car and some other trades the outlook is not reassuring. In these circumstances more attention is paid to the renewal of the Cartel, and in Paris there is a tendency to give way to the Germans over the question of the international sales organisation in the hope that it will enable them to re-organise their own steel unions and prepare the way for a continuance of the Cartel, which until recently the French refused to do. It is perfectly obvious that continental steel makers fear that they will have to deal with an importation of American steel into Europe, and they see that their safety lies in an organisation which will enable them to take measures for the protection of their own interests.

Labour.

The metallurgical and engineering industries have developed so largely during the past decade that the demand for skilled or specialised labour has far exceeded the home supply, and it has only been met by the importation of hands from other countries, notably from Italy, Belgium, and Poland. Those men came to France with contracts for definite periods, but on the termination of the agreements the majority of them remained in the country, thereby raising a problem of migration which caused trouble with the various countries concerned. Italy put an embargo upon emigration and restrictions were imposed elsewhere, with the result that the French industry is confronted with the prospect of further expansion being arrested through want of an adequate supply of labour. The Government has therefore been in negotiation with various countries in the hope of settling upon conditions under which they will allow men to emigrate temporarily to France. One arrangement has been entered into with Rumania whereby 10,000 men will be provided for a period of one year for the engineering industries.

Canals.

The construction of a canal between the colliery district in the Nord and Paris was decided upon before the war. Since then little has been done, because the original plans did not provide for barges of a tonnage which is now regarded as necessary for economic transport, and the new proposals involve so great an expenditure that the State hesitates to participate in it. The increased cost is due mainly to the construction of bigger locks with electrical equipment and the necessity of pumping water for the canal from the Arleux marshes. Nevertheless, great pressure continues to be brought to bear upon the Government to complete an undertaking which is regarded as necessary in view of the inability of the Saint-Quentin Canal to deal with the traffic ; but, as the freight consists mainly of coal, it is doubtful whether there will be sufficient to justify the huge expenditure in view of the arrangements now being made to distribute gas from the collieries by a pipe line to Paris. The managing director of the Nord Railway Company suggests that, if the excavation for the canal is proceeded with, it will be more profitable to lay a railway track at the bottom.

Water Distillation.

The water supply in Algeria and Tunis is usually deficient, both in quantity and quality, and in some of the southern territories it is so bad that it cannot be used except after distillation. At certain military stations bordering on the desert the water is so heavily charged with magnesia salts that the Office National des Recherches et Inventions was entrusted with the task of evolving some method of distillation on a sufficiently large scale by means of solar heat. As the result of experiments carried out in Paris and in North Africa an installation was devised and for some months past has been giving satisfactory results. It consists of batteries of shallow rectangular pans made of 19-gauge corrugated sheet iron painted black on both sides, with a plug in the centre of each for the removal of sludge. The pan is covered with glass inclined at a suitable angle to the sun. Water is admitted to the pans from a pipe behind and, condensing on the underside of the glass cover, trickles down to a collector. A battery consists of sixty pans and was expected to distil 100 litres a day. As one half of the battery could not be put in operation through failure to reach its destination in time, the experiments were carried out with the other half at another fort in the south of Tunis. All through the summer it has been distilling 67 litres a day.

The Paris Termini.

The work of extending the Gare Montparnasse and the Gare de l'Est is well advanced, and it is expected that the latter station will be entirely completed in 1931, when the number of tracks will have been increased from eighteen to thirty, with fifteen platforms 300 m. long and 7 m. wide. This extension has been rendered necessary by the traffic with Alsace-Lorraine, and, besides accelerating the main line traffic, it will allow of close upon a thousand suburban travellers being sent away every minute. The scheme for building low-level platforms at the Gare St. Lazare for the suburban traffic appears to have been shelved, at any rate for the present, and the congestion at that station will be partly relieved by diverting some of the main line traffic to the Gare Montparnasse.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

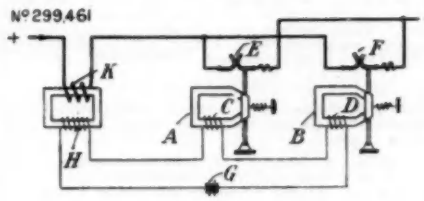
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application ; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

SWITCHGEAR.

299,461. October 23rd, 1928.—QUICK-ACTING SWITCHES FOR HEAVY DIRECT CURRENTS, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

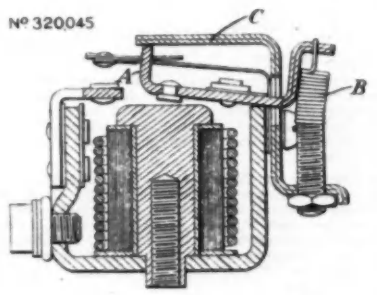
An example of a quick-acting switch arrangement is shown in the accompanying drawing with two interrupting points connected in parallel. A and B are the magnet systems with the holding-on coils C and D excited from a source of continuous current. The switch contact members E and F are connected in parallel. In the circuit of the holding-on coils C and D, which



are connected in series or parallel, and the source of current G, is the secondary winding H of a transformer, the primary winding K of which carries the main current so that these coils carry both the separate direct excitation and that derived from the main current through the transformer. The opening of the switches in the event of a short circuit is thus caused by the inductive effect of a rapid rise in the main current by means of a transformer which is common to all the switches, and the result is thus obtained that all parallel connected switches open simultaneously.—*October 10th*, 1929.

320,045. April 18th, 1928.—ELECTRO-MAGNETIC CUT-OUTS, SWITCHES AND THE LIKE, Albert Henry Midgley, of Fairfield, Harefield-road, Uxbridge, Middlesex.

In a cut-out constructed in accordance with this invention means are provided for automatically varying the air gap or the tension or compression of the spring controlling the armature so as to compensate for temperature variations in order to main-

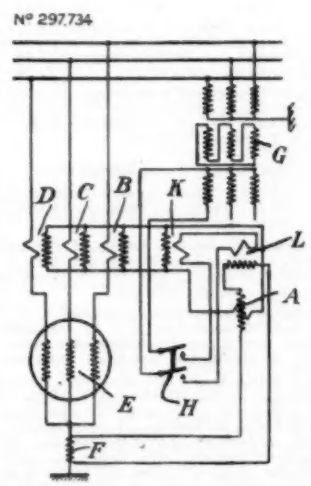


tain the operation of the device substantially constant for all temperature variations as normally experienced in the operation of the apparatus. The armature A is controlled by a spring B and has its movement away from the electro-magnet limited by an arm C, which, as already indicated, is made of a thermostatic metal so as to vary the air gap between the armature and the pole face in accordance with variations in temperature.—*September 18th*, 1929.

MEASURING AND TESTING INSTRUMENTS.

297,734. September 5th, 1928.—ELECTRICAL FAULT INDICATING AND PROTECTIVE DEVICES, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

The invention refers to an apparatus for supervising fault indicating or protective apparatuses used with electrical

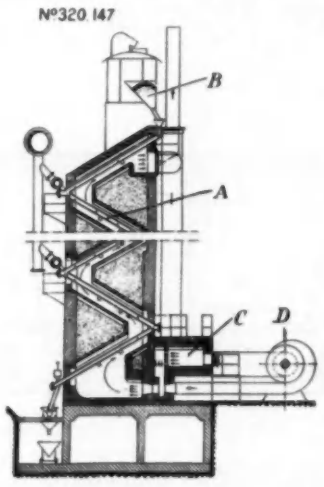


machines. Such a supervision is necessary, since at times, especially when the deflection of the fault indicating apparatus in the normal state is equal to zero, it is impossible to say whether the fault indicating apparatus is itself in order. The drawing shows the supervising apparatus of an "earth" indicating or protective device. The "earth" indicating device A consists of an instrument which is constructed on the lines of a wattmeter relay. Its current coil is connected to the three parallel-connected secondary windings of the current transformers B C D, the primary sides of which are connected to the conductors of the generator E to be supervised. The potential coil of the "earth" indicating apparatus A is connected to a potential transformer F which is connected between the neutral point of the generator E and earth. A choking device G is arranged in the installation and forms an artificial neutral point. It has a three-phase primary winding connected to the bus-bars and a secondary winding connected in delta and short circuited in itself. An arrrrangement of this kind, which is already known, has the property that its primary star point, even with one-sided loading, approximately coincides with the electrical neutral point of the mains. The primary star point of the apparatus is earthed. The apparatus has a third winding connected in star, which can be used for connecting to a voltmeter or other measuring instrument. According to the invention, a potential supplied by this third winding of the choking device is supplied to the "earth" indicating relay A for the purpose of supervision. The potential taken from the choking device is connected through a double testing key H to the primary windings of two current transformers K and L, of which the secondary winding of the current transformer K supplies the current coil of the "earth" indicating relay A and the secondary winding of the current transformer L the potential coil of the apparatus A.—*October 10th*, 1929.

GAS PRODUCERS.

320,147. July 13th, 1928.—LOW-TEMPERATURE CARBONISATION, *J. Y. Johnson*, 47, *Lincoln's Inn-fields, London, W.C.* 2.

The inventors claim that they have found it possible to feed forward bituminous material in a low-temperature retort by gravity alone. The retort takes the form of a zigzag pipe A in an appropriate setting. The coal is fed in from the hopper B and encounters a series of baffles within the pipe. The result is

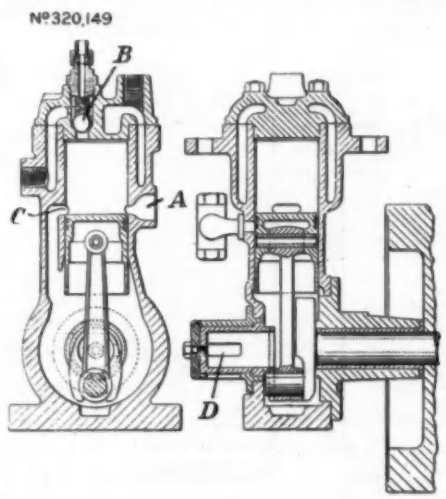


that the coal flows downward in a stream from 50 mm. to 60 mm. deep and leaves about 70 per cent. of the cross-sectional area of the pipe free for the ascension of the distilled gases. The heating furnace is shown at C and is designed to work at a high temperature. The temperature in the setting is, however, moderated by the circulation of the inert products of combustion by means of the fan D.—*October 10th*, 1929.

PUMPING AND BLOWING MACHINERY.

320,149. July 16th, 1928.—AIR COMPRESSORS, F. Bullock, Culcheth-lane Works, Newton Heath, Manchester.

It is claimed that this compressor can be run at a higher speed than is usual. In it the inlet port A is uncovered at the end of the down stroke by the piston and admission then takes place. The port is recovered on the upstroke and the compressed air is



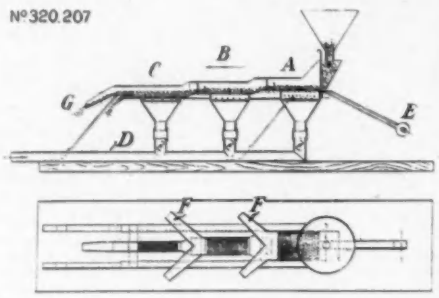
discharged through the delivery valve B. It is said that "in addition to or in lieu of" the inlet port A, one or more other ports C may be provided. These ports communicate with the crank case, in which the air receives a preliminary compression. The inlet valve to the crank case is of the rotary form, as shown at D. —*October 10th*, 1929.

MINING MACHINERY.

320,207. September 10th, 1928.—PNEUMATIC CLASSIFIERS, P. Soulary, Bruay-en-Artois (Pas-de-Calais), France ; and Compagnie des Mines de Bruay.

This coal classifier is of the pneumatic type, in which the coal and dirt are stratified on a jigging table by an upward blast of air The table is divided into three or more sections A B C, and

each part is provided with a separate air blast from the trunk D. The jigging mechanism is shown at E. At the outlet end of each section of the table there is a skimmer plate, which takes off the upper layer of coal and diverts it either to the side, as

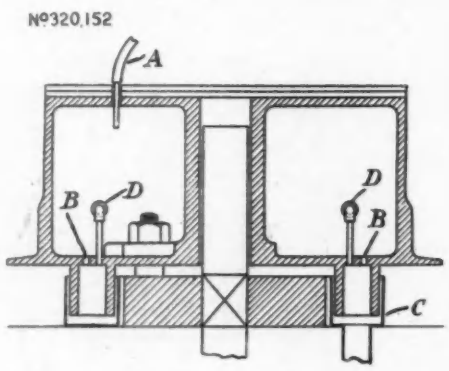


at F F, or over the end as at G. An essential feature of the invention is that the successive sections of the table are reduced in width, and it is claimed that in this way the loss of clean coal, through the defective adjustment of the skimmer plates, is minimised.—*October 10th*, 1929.

MACHINE TOOLS AND SHOP APPLIANCES.

320,152. July 18th, 1928.—Wire-drawing Blocks, E. W. T. Rees, 16, Westbourne-crescent, Whitchurch, near Cardiff.

The inventor cools his wire-drawing block by means of the circulation of water, as a provision against "overheating, such as is detrimental to the ductility of the wire, a feature of importance to wire generally and especially so in wire rope." The block, it will be seen, has a closed top and is supplied with

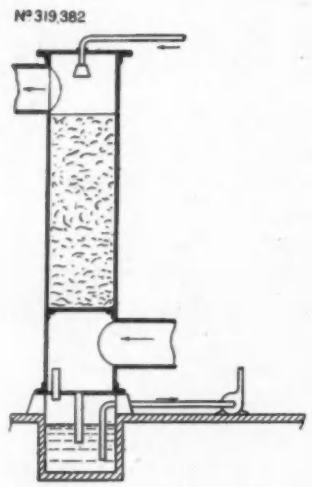


cooling water through the flexible swivelling pipe A. Drain holes are provided at B B and discharge into the annular trough C, but they are of such a size that they will not pass as much water as is supplied by the pipe A. As a consequence the water level rises until the water overflows by the pipes D D. The holes B B allow the block to be drained when the water supply is cut off.—*October 10th*, 1929.

MISCELLANEOUS

319,382. May 23rd, 1928.—The Purification of Coal Gas, The Manchester Oxide Company, Ltd., Canal-street, Miles Platting, Manchester; and R. H. Clayton.

The inventors state that they have found that the removal of "tar fog" from coal gas can be effected in a very cheap and simple manner which obviates the necessity of using expensive washing plant or other apparatus. "We have," they go on to say, "found, in fact, that if the hot gas taken from between the hydraulic main and the condensers is passed up a tower maintained at a temperature above the dew point of the gas for water and packed with a suitable packing material—and for this purpose we prefer to use rings of the Raschig type—the whole or the greater part of the 'tar fog' can be eliminated and the recovered



tar which collects at the bottom may be run off. The removal of the 'tar fog' in this manner considerably assists the subsequent purification of the gas and also prevents the polyhydric phenols or 'higher tar acids'—which we have found to be mainly, if not wholly, contained in this 'tar fog'—from passing into the condensers and dissolving in the alkaline liquor, thereby reducing the oxygen-absorbing capacity of the ammonia still effluent liquor, subsequently obtained when the alkaline liquor is distilled. The contaminations of the ammonia still effluent liquor with these 'higher tar acids' is one of its main objections as a sewage effluent. We have also found that if a suitable absorbent, and for this purpose we have used dephenolated tar, is fed down the tower against the upward stream of hot gas, a considerable portion of the other oxidisable bodies may also be removed from the gas, with a further reduction in the contamination of the ammonia still effluent liquor. It is a further advantage that when dephenolated tar or tar oil is employed for washing the crude gas the lighter phenols, especially monohydric phenol, which are in the vaporised form, are removed from the gas. The invention therefore includes broadly the employment of dephenolated tar or tar oil as an agent for washing phenolic bodies from crude gas." There is a large amount of other information in this specification, which is accompanied by the drawing of the tower reproduced. This drawing hardly needs explanation.—*September 23rd*, 1929.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Royal Aeronautical Society: Postponed Lecture.—The lecture by Senr. de la Cierva on "Recent Work on the Autogiro," originally fixed for December 5th next, has been unavoidably postponed. The lecture will be delivered by Senr. de la Cierva in the second half of the present Session.

TO-DAY.

Institute of Fuel.—Lecture Theatre at University College, Nottingham. "Coals and their Impurities," by Dr. J. W. Whitaker. 7 p.m.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, London, S.W. 1. General meeting. "Journal Bearing Practice," by Mr. Francis Hodgkinson, of Philadelphia, U.S.A. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. "Nickel and its Uses in Engineering," by Mr. W. T. Griffiths. 7.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Bolbec Hall, Newcastle-upon-Tyne. "The Behaviour of a Cargo Vessel during a Winter North Atlantic Voyage," by Dr. B. C. Laws. 6 p.m.

Royal Aeronautical Society.—St. Ermin's Hotel, Caxton-street, Westminster S.W. 1. Informal dinner and discussion. 7.30 p.m.

West of Scotland Iron and Steel Institute.—In the "Societies' Room," No. 24, Royal Technical College, George-street, Glasgow. The Council will meet at 7 p.m. in Committee Room No. 26. "Steel Research," by Professor J. H. Andrew; cinema film will be shown, "From Ore to Finished Product." 7.30 p.m.

TO-DAY and SATURDAY, NOVEMBER 16th.

International Commercial Motor Transport Exhibition.—Olympia, W. Daily, 10 a.m. to 9 p.m.

MONDAY, NOVEMBER 18th.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, London, S.W. 1. Graduates' Section, London. Joint meeting with Students' Sections of Institution of Civil Engineers and Institution of Electrical Engineers. "Artificial Lighting of Factories and Public Buildings," by Mr. A. G. Brown. 7 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. Cantor Lecture, "Wind Instruments from Musical and Scientific Aspects," by Dr. E. G. Richardson. Lecture I.: Sounds of Pipes and Methods of Exciting them. Primitive Pipes, The Hydraulus and early Organ Pipes. The Introduction of Side Holes. Precursors of the Flute. Early Reed Pipes and Reed Instruments. The Introduction of Keys. Early Brass Instruments. 8 p.m.

MONDAY, NOVEMBER 18th, to SATURDAY, NOVEMBER 23rd.

Public Works, Roads and Transport Congress and Exhibition (1929).—Royal Agricultural Hall, London, N. For programme of Congress, see page 422.

TUESDAY, NOVEMBER 19th.

Institute of Automobile Engineers: Coventry Graduates.—Broadgate Café, Coventry. "The Case-hardening of Alloy Steels," by Mr. H. Swain. 7.15 p.m.

Institution of Automobile Engineers: London Graduates.—Watergate House, Adelphi, W.C. 2. Informal meeting. Discussion, "Failures and Breakages." 7.25 p.m.

Institution of Automobile Engineers: Wolverhampton Centre.—Engineering and Scientific Club, Queen-street, Wolverhampton. "The Mercédès-Benz Diesel Engine," by Mr. W. H. Goddard. 7.30 p.m.

Institution of Civil Engineers.—Great George-street, Westminster, S.W. 1. Paper to be submitted for discussion, "Some Experimental Methods and Apparatus for Determining the Stresses in Bridges and Framed Structures," by Professor Ernest George Coker.

Institution of Electrical Engineers: North Midland Students' Section.—At the Hotel Metropole, Leeds. Discussion on the question, "Should the Railways be Electrified?" opened by Mr. H. J. Fraser. 7.30 p.m.

WEDNESDAY, NOVEMBER 20th.

Institution of Civil Engineers.—Great George-street, Westminster, S.W. 1. Students' Meeting. Address by Mr. Gilbert Charles Bunn. 6.30 p.m.

Newcomen Society.—In the Rooms of the British Sea Anglers' Society, 4, Fetter-lane, Fleet-street, E.C. 4. Annual General meeting, "D'Acres' 'The Art of Water Drawing,' 1659," by Mr. Rhys Jenkins. 5.30 p.m.

Overhead Lines Association.—Institution of Electrical Engineers, Victoria Embankment, W.C. 2. "Standard Intermediate Voltages for Rural Electrification" (cinematograph illustrations), by Mr. R. Borlase Matthews. 5.30 p.m.

Royal Meteorological Society.—49, Cromwell-road, South Kensington. A Special General Meeting. Proposed alterations and additions to By-laws. To admit persons not of British nationality to the Society as Foreign Members. "The Physical Conditions Controlling Visibility through the Atmosphere," by Mr. M. G. Bennett. "The Reflectivity of Woodland, Fields and Suburbs between London and St. Albans," by Dr. L. F. Richardson, F.R.S. "The Electric Charge on Rain," by Miss Thora C. Marwick. 5 p.m.

Royal Microscopical Society.—20, Hanover-square, London, W. 1. Meeting at 8 p.m.

Royal Society of Arts.—John-street, Adelphi, W.C. 2. "The Protection of Rural England," by Mr. P. Morley Horder. 8 p.m.

THURSDAY, NOVEMBER 21st.

British Waterworks Association.—Agricultural Hall Islington, London, N. General meeting. Papers:—(a) "Water Supply as a Factor in Town and Regional Planning," by G. L. Pepler, F.S.I.; (b) "The Purity of Drinking Waters from the Biological Aspect," by Dr. W. Rushton, D.I.C., A.R.C.Sc. (Lond.), F.L.S.; and (c) "The Preservation of Rivers and Streams from the Standpoint of Water Supply: Some Observations on River Pollution," by Dr. J. B. Firth, D.Sc. 11 a.m. and 3 p.m.

Institute of Fuel.—Joint meeting with Institution of Electrical Engineers in the Lecture Theatre of the Institution, Savoy-place, Victoria Embankment, London, W.C. 2. "Low-temperature Carbonisation in connection with the Production of Electricity," Messrs. E. H. Smythe and E. G. Weeks, Mr. S. McEwen, Professor R. Rosin. 6 p.m.

Institution of Automobile Engineers.—Joint meeting with the Royal Aeronautical Society, at the Royal Society of Arts, John-street, Adelphi, W.C. 2. "The Inspection of Metals and their Alloys," by Capt. L. W. Johnson. 7.45 p.m.

FRIDAY, NOVEMBER 22nd.

Institution of Automobile Engineers: Coventry Centre.—King's Head Hotel, Coventry. Annual dinner. 7.30 p.m. for 8 p.m.

Institution of Engineering Inspection.—At the Rooms of the Royal Society of Arts, John-street, Adelphi, London, W.C. 2. "Saws: Their Manufacture and some Hints on their Use," illustrated by lantern slides and exhibits, by Mr. T. W. Willis. 5.30 p.m.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, London, S.W. 1. Informal meeting. "The Utilisation of Low-grade and Refuse Fuels, including Towns' Refuse," to be introduced by Mr. J. S. Atkinson. 7 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Ordinary meeting. "The Quick-running Oil Engine as applied and used in Railway Service," by Mr. H. D. Bush. Slides. 7.30 p.m.

SATURDAY, NOVEMBER 23rd.

Institution of Civil Engineers.—Students' Visit, Saturday (Morning), to the London General Omnibus Company's Works, Chiswick.

MONDAY, NOVEMBER 25th.

Institution of Automobile Engineers: Scottish Centre.—Royal Technical College, Glasgow. "The Mercédès-Benz Diesel Engine," by Mr. W. H. Goddard. 7.30 p.m.

Royal Society of Arts.—John-street, Adelphi, W.C. 2. Cantor Lecture, "Musical and Scientific Aspects of Wind Instruments," Lecture II., by Dr. E. G. Richardson. 8 p.m.

TUESDAY, NOVEMBER 26th.

Institute of Marine Engineers.—85-88, The Minories, London, E.C. 3. "The Origin and Development of Heavy Oil Engines" (Akroyd Stuart Award Prize Paper, 1929, Abridged), by Mr. A. F. Evans. 6.30 p.m.

Institute of Metals: Birmingham Local Section.—In the Chamber of Commerce, New-street. "The Modern Development of the Steam Locomotive," by Mr. G. W. Woolliscroft. The paper forms part of a joint programme arranged by the Birmingham Metallurgical Society, the Staffordshire Iron and Steel Institute, and the Birmingham Local Section of the Institute of Metals. 7 p.m.

Institution of Automobile Engineers: Western Graduates.—Canteen at the works of the Bristol Tramways and Carriage Company, Ltd., Brislington, Bristol. "Braking Topics," by Mr. E. W. Sisman. 7.30 p.m.

Institution of Electrical Engineers: Scottish Centre.—The Grosvenor Restaurant, Gordon-street, Glasgow. Annual dinner and ladies' evening.

WEDNESDAY, NOVEMBER 27th.

Institute of Physics.—In the Rooms of the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2. Public Lectures on Physics in Industry. No. 15, "Physics in relation to the Utilisation of Fuel," by Dr C. H. Lander. 5.30 p.m.

Institution of Automobile Engineers: North of England Centre.—Engineers' Club, Albert-square, Manchester. "The High-speed Compression-ignition Heavy-oil Engine," by Mr. F. R. Banks. 7 p.m.

Institution of Chemical Engineers.—In the Rooms of the Chemical Society, Burlington House, Piccadilly, London, W. 1. "Production and Treatment of Cellulose in the Paper Industry." by Mr. James Strachan. 8 p.m.

Institution of Municipal and County Engineers: North-Western District.—In the Manchester Town Hall (Lloyd-street entrance). The meeting is to take the form of "Parliamentary Bill Proceedings," and will be run on similar lines to the special meetings of last Session. 6 p.m.

Royal Society of Arts.—John-street, Adelphi, W.C. 2. Dr. Mann Lecture, "The Examination of Coal and Coke by X-rays," by Mr. C. Norman Kemp. 8 p.m.

THURSDAY, NOVEMBER 28th.

Institution of Automobile Engineers: Luton Graduates.—Royal Hotel, Mill-street, Luton. "The Automobile Compression Ignition Engine," by Mr. S. W. Dixon. 7.30 p.m.

Institution of Automobile Engineers.—Y.M.C.A. Dining Hall, Blackett-street, Newcastle-on-Tyne. "The Pneumatic Tire in Heavy Transport," by Mr. A. Healey. 8 p.m.

FRIDAY, NOVEMBER 29th.

Institution of Automobile Engineers: Scottish Graduates.—Regent Restaurant, 51, West Regent-street, Glasgow. "Two-stroke Engines: Some Experiments on a New Type," by Mr. J. W. Robertson. 8 p.m.

Institute of Marine Engineers.—At the Hotel Victoria, Northumberland-avenue, W.C. 2. Annual conversazione. Reception, 7 to 7.30 p.m.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, London, S.W. 1. Extra general meeting. An open debate on "The Registration of Reliable Tests of Power Plant Machinery," to be introduced by Mr. R. H. Parsons. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Informal meeting. Lecture, "Modern Welding Systems and Applications," by Mr. W. C. Freeman. 7.30 p.m.

SATURDAY, NOVEMBER 30th.

Institute of Metals: Birmingham Local Section.—Queen's Hotel, Birmingham. Fourth annual dinner and ladies' night.

MONDAY, DECEMBER 2nd.

Institution of Automobile Engineers: Loughborough Graduates.—The College, Loughborough. "Carburettors and Carburation," by Mr. H. G. Nicoll. 7 p.m.

Institution of Automobile Engineers: Western Centre.—Merchant Venturers' Technical College, Bristol. "The Relative Safety of Mild and High Tensile Steel Under Alternating and Pulsating Stresses," by Dr. B. P. Haigh. 6.45 p.m.